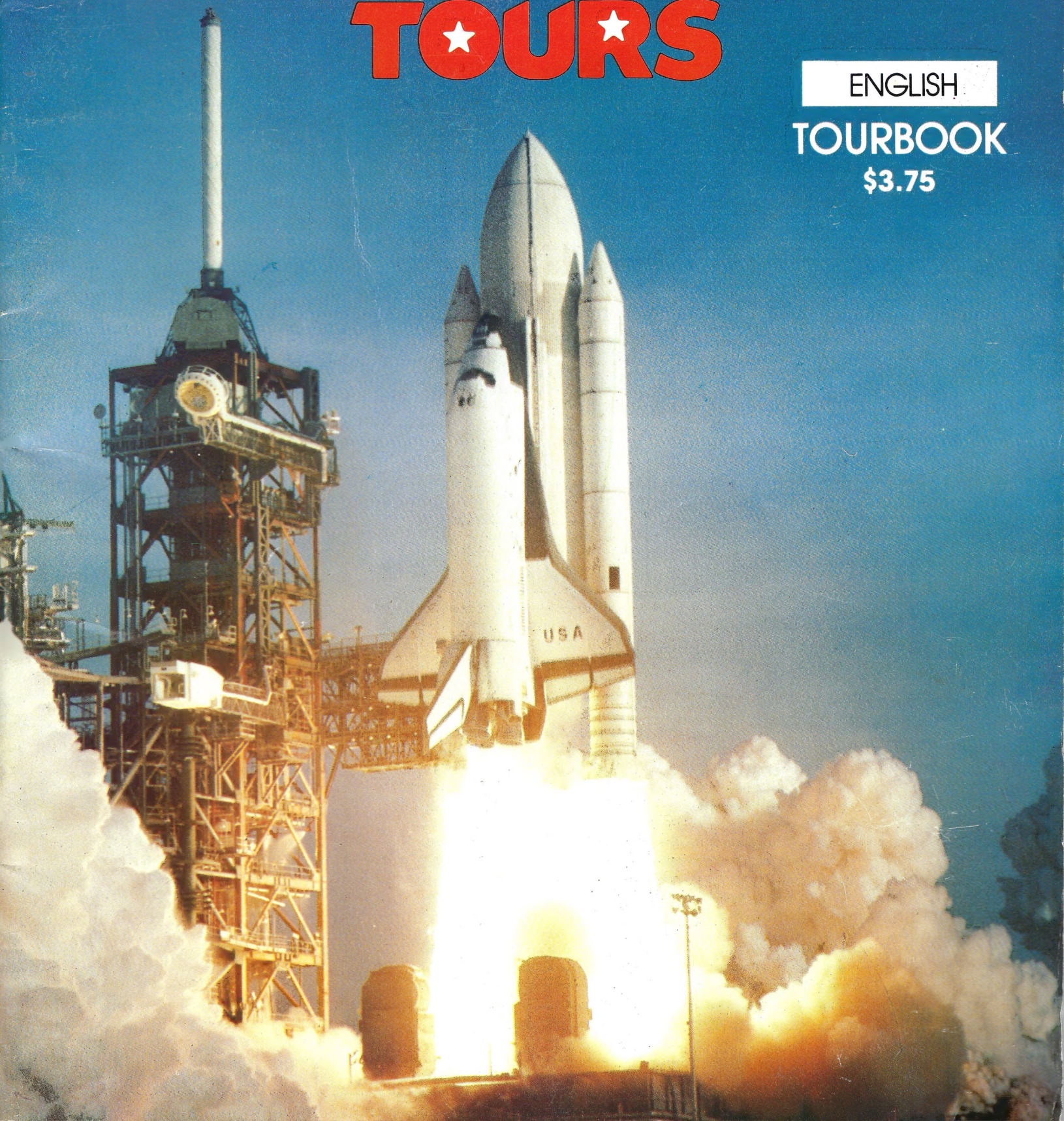
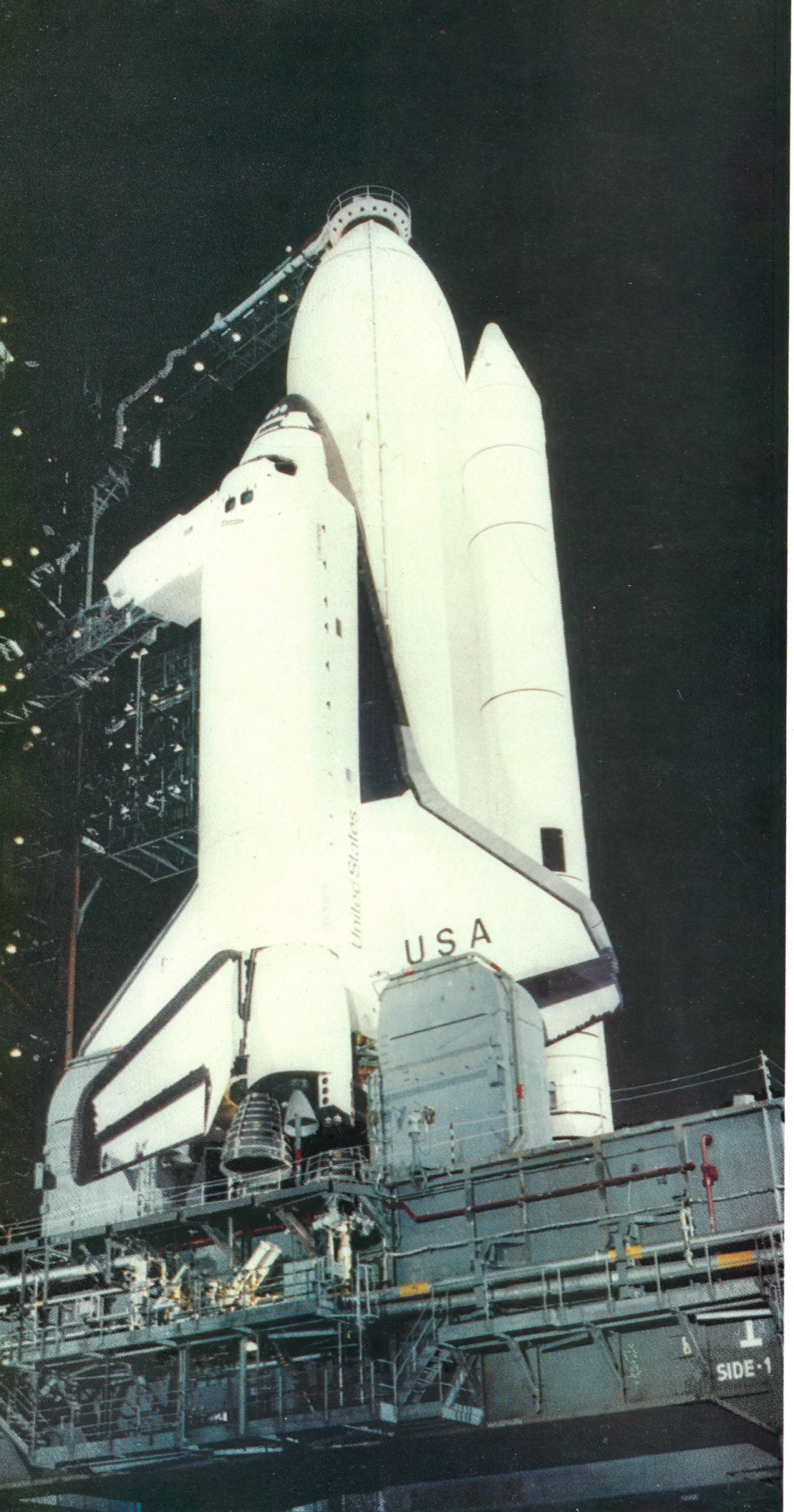
# KENNEDY SPACE CENTER TOURS

ENGLISH

TOURBOOK

$3.75





Dear Visitor:

Welcome to the John F. Kennedy Space Center, where travel between Earth and Space begins and ends.

In the early days of the space program, space vehicles launched from here were sent on a one-way journey. Some will continue through the outer reaches of space for years to come. Others re-entered Earth's atmosphere and were destroyed.

In the Manned Space Flight Program, our astronauts returned from Earth orbit and their Moon visits by landing their spacecraft in the ocean. But during your visit here today, you will see facilities for the Space Shuttle — a spacecraft that is revolutionizing the way space is explored and used. You will see not only the launch pad (perhaps with a Shuttle awaiting its launch), but also the landing runway where Shuttle crews bring back their spacecraft and cargo to a "conventional" landing.

With the era of Space Shuttle, the space program and the Kennedy Space Center come of age. The promise of routine access to space is being realized. I hope your visit here today enables you to share in the excitement and the fulfillment felt by those of us who work here.

Sincerely,

Richard G. Smith
Director
John F. Kennedy Space Center

# KENNEDY SPACE CENTER TOURS

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# MAP OF KENNEDY

In the years following World War II, America's rockets began to outgrow the range available in the western desert, so the War Department selected Cape Canaveral as the testing area for long-range guided missiles. Formal approval of the site was given on July 8, 1947 and the Atlantic Missile Range came into existence. Cape Canaveral Air Force Station is Station One of a test range that extends over 16,000 kilometers (10,000 miles) into the Indian Ocean.

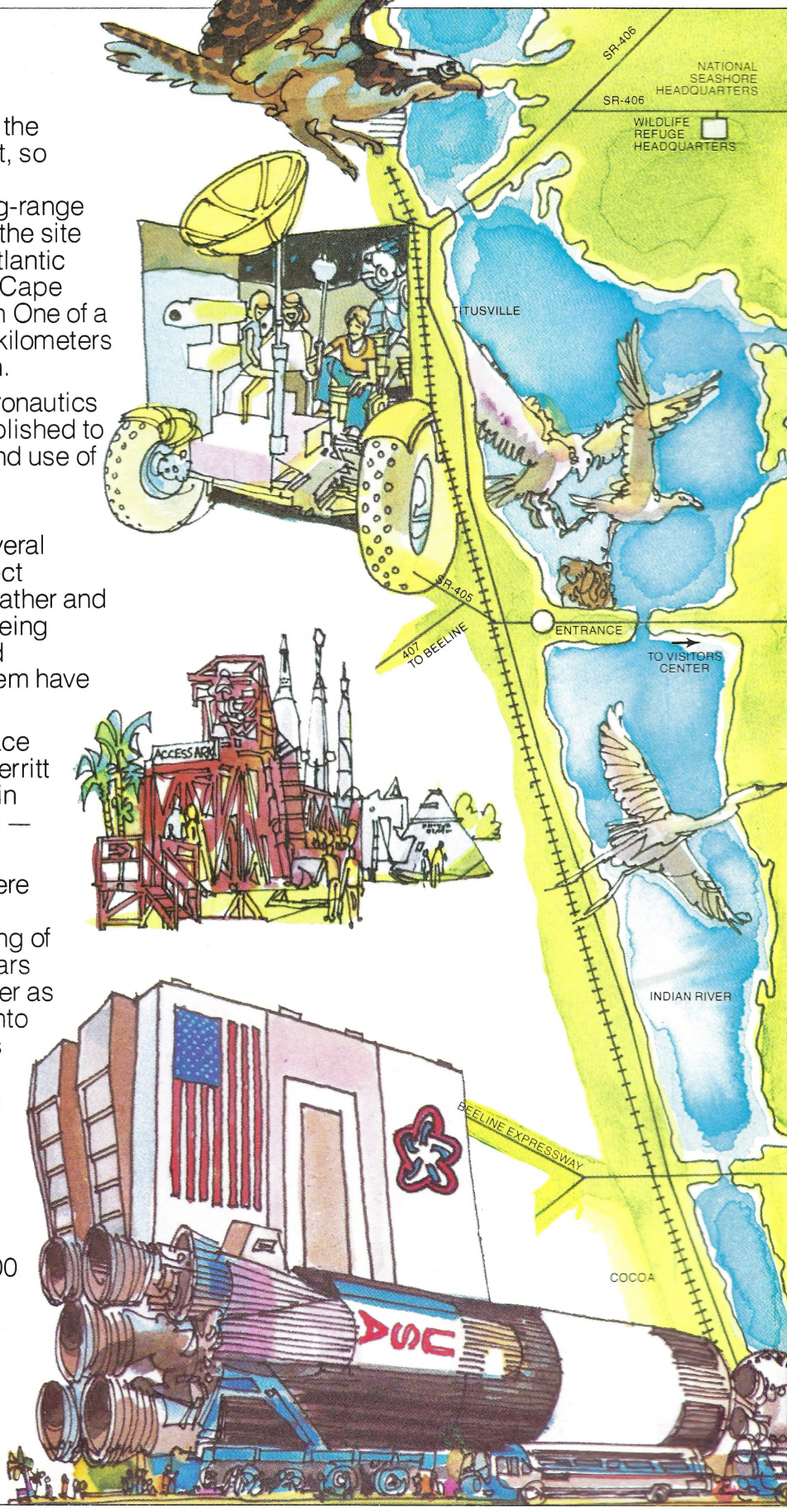
On October 1, 1958 the National Aeronautics and Space Administration was established to carry out the peaceful exploration and use of space.

The early focus of NASA's launch operations centered on Cape Canaveral where the manned launches of project Mercury and Gemini took place. Weather and communications satellites are still being launched from the Cape. Automated spacecraft to explore our Solar System have also been launched.

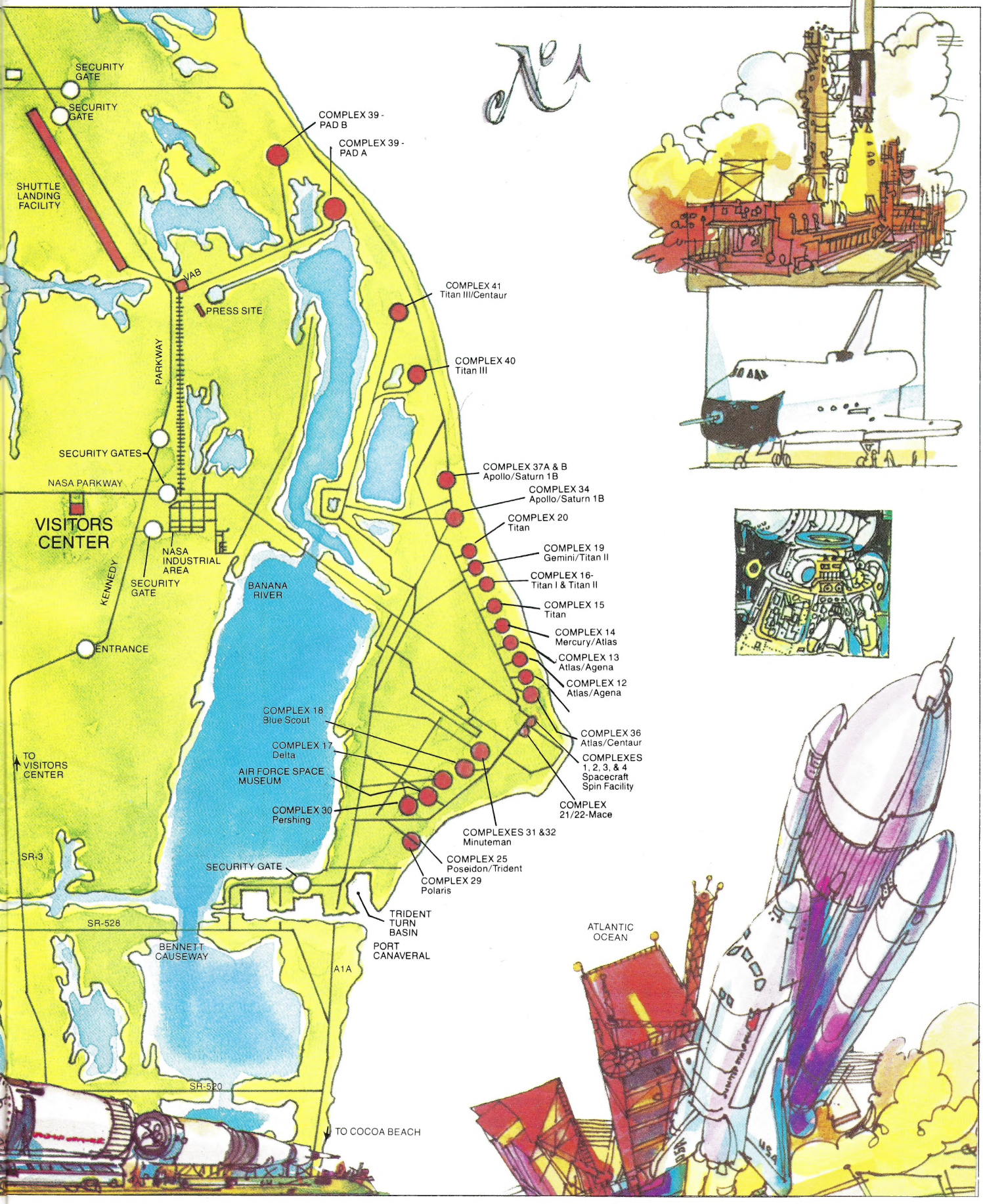
In late 1964 the NASA Kennedy Space Center was relocated to adjacent Merritt Island. This site had been selected in 1961 as the launch facility for Apollo — the Moon Mission.

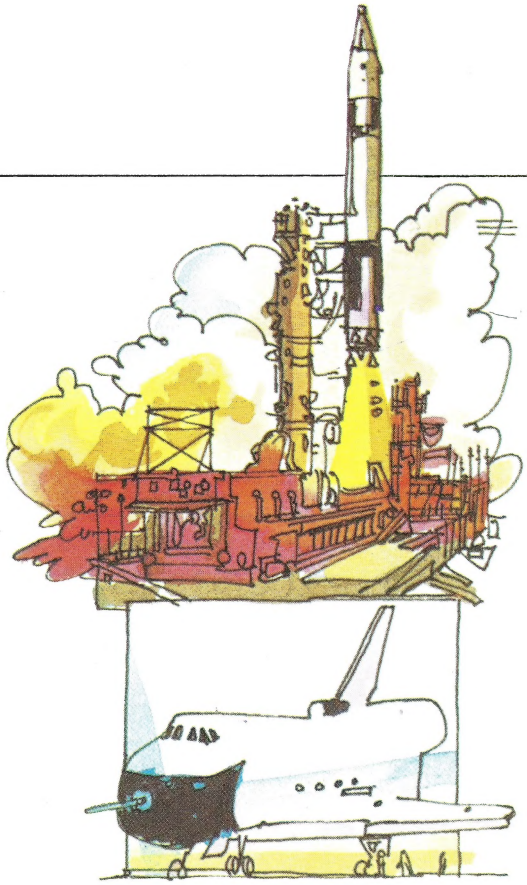
Beginning in 1976 these facilities were modified and new ones built to accommodate the launch and landing of the Space Shuttle. In the coming years the Spaceport will be busier than ever as the reusable Space Shuttle is sent into earth orbit over and over again. This revolutionary and reusable space transportation system will enable us to sail the ocean of space as routinely as ships now sail the oceans of water and airlines the ocean of our atmosphere.

All but the operational areas of the Spaceport's 34,000 hectares (84,000 acres) are designated as a National Wildlife Refuge, much of which is open to the public. In 1975, 16,600 hectares (41,000 acres) of the spaceport were designated as part of the Canaveral National Seashore.



# SPACE CENTER, NASA



# Tour Information

Guided bus tours of the Kennedy Space Center are offered every day of the year except Christmas Day. They offer enlightening glimpses into the accomplishments of the past and the challenges and opportunities that await us in the future. Your tour covers terrain first viewed by the exploring Spaniards four and a half centuries ago and the training grounds and launch facilities for astronauts who walked upon the surface of the Moon. Along the tour route, WHICH MAY BE VARIED SLIGHTLY DUE TO OPERATIONAL REQUIREMENTS, you will view the Industrial Area with its administrative offices, laboratories and processing facilities for Space Shuttle payloads. A tour stop at the Flight Crew Training Building includes a dramatic sight and sound show with a real Lunar Module on a realistic simulation of the Moon's surface.

Your tour may take you to the massive facilities of Complex 39, launch site for the daring Apollo voyages to the Moon, and Skylab, America's first space station. Complex 39 is now the home of the Space Shuttle. Here you may stop adjacent to the Vehicle Assembly Building (VAB) one of the world's largest structures, and the Apollo/Saturn V, the most powerful space vehicle ever flown. You will view the giant crawler-transporters which move Mobile Launch Platforms and flight hardware from the VAB to the launch pads. OPERATIONS PERMITTING you will view launch pads at Complex 39 where Apollo/Saturn rockets rumbled into space on tongues of flame and from where Space Shuttle is launched. You will view the Press Site from which space missions are covered by news media representatives from around the world.

When the Space Shuttle is on the launch pad, restrictions on tour routes due to safety and security requirements may prevent stops for picture taking and require that bus windows not be opened at any time.

You will be leaving the bus at several points of interest. Each time you leave the bus, please take

Entrance to the Kennedy Space Center

We will be happy to assist you in any way to make your visit with us most memorable

## RED TOUR

5
7

- Part of Tour Not Operating Today.
- Einige Sehenswürdichkeiten von dieser Tour können heute nicht gezeigt werden.
- Secciones de la excursión que no están en operación hoy.
- Porções da excursão que não estao operando hoje.
- Non inclus dans la visite d'aujourd' hui.

all of your possessions with you, since it is possible that you may not return to the same bus. As you get off the bus or as you approach stairways or parking curbs, please step carefully. While off the bus, please stay together as a group and do not leave the area near the bus. And, most important, please keep your conversation to a minimum so that everyone can hear your tour escort. . . . Thank you for your cooperation.

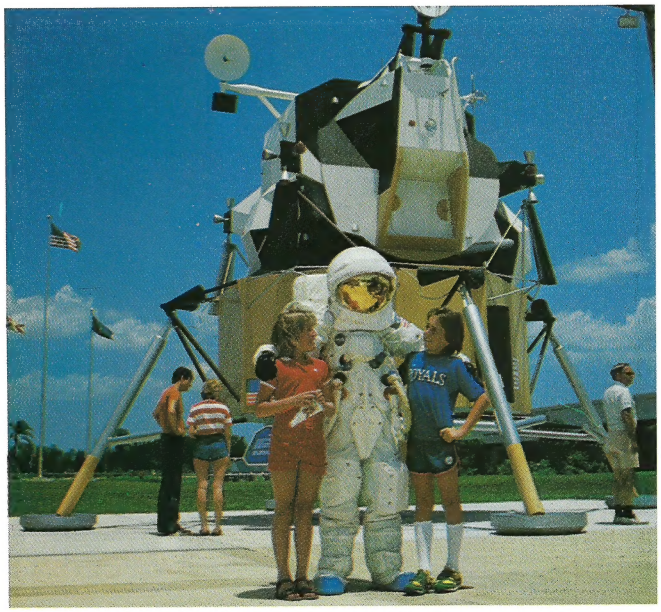
We here at the Kennedy Space Center are ready to serve you in every way we possibly can. We want your visit to be a thrilling and informative experience you will long remember.

We would like to remind you that if you have a pet, please do not leave the pet in your automobile. We have free kennel service. If you want your pet to have food or water, please provide dishes for this. Check in at the Departure Control office for details.

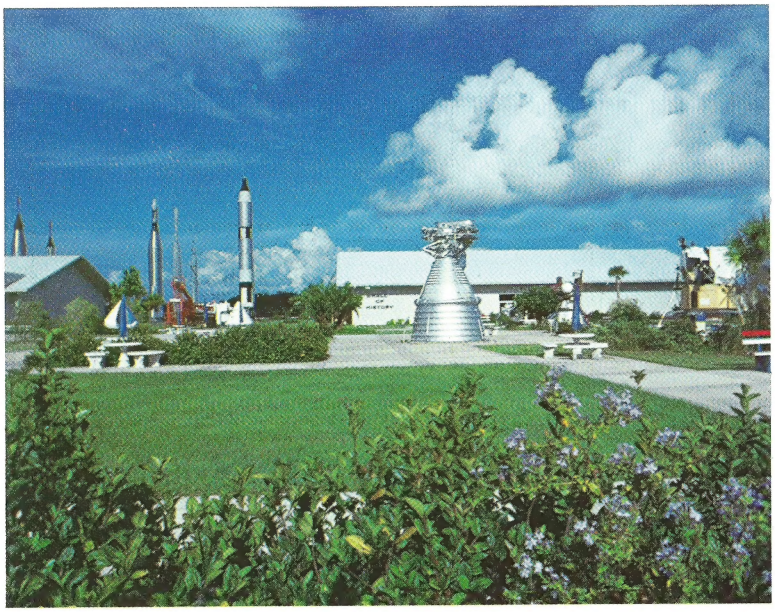
Our bilingual Information Agents may be able to help in currency exchange, provide information on how to get to the next stop on your tour of the Sunshine State and, of course, help you understand any American words or phrases that are difficult to translate.

If you are planning to stay in this area overnight, or for the next few days, they can assist you with motel and restaurant information.

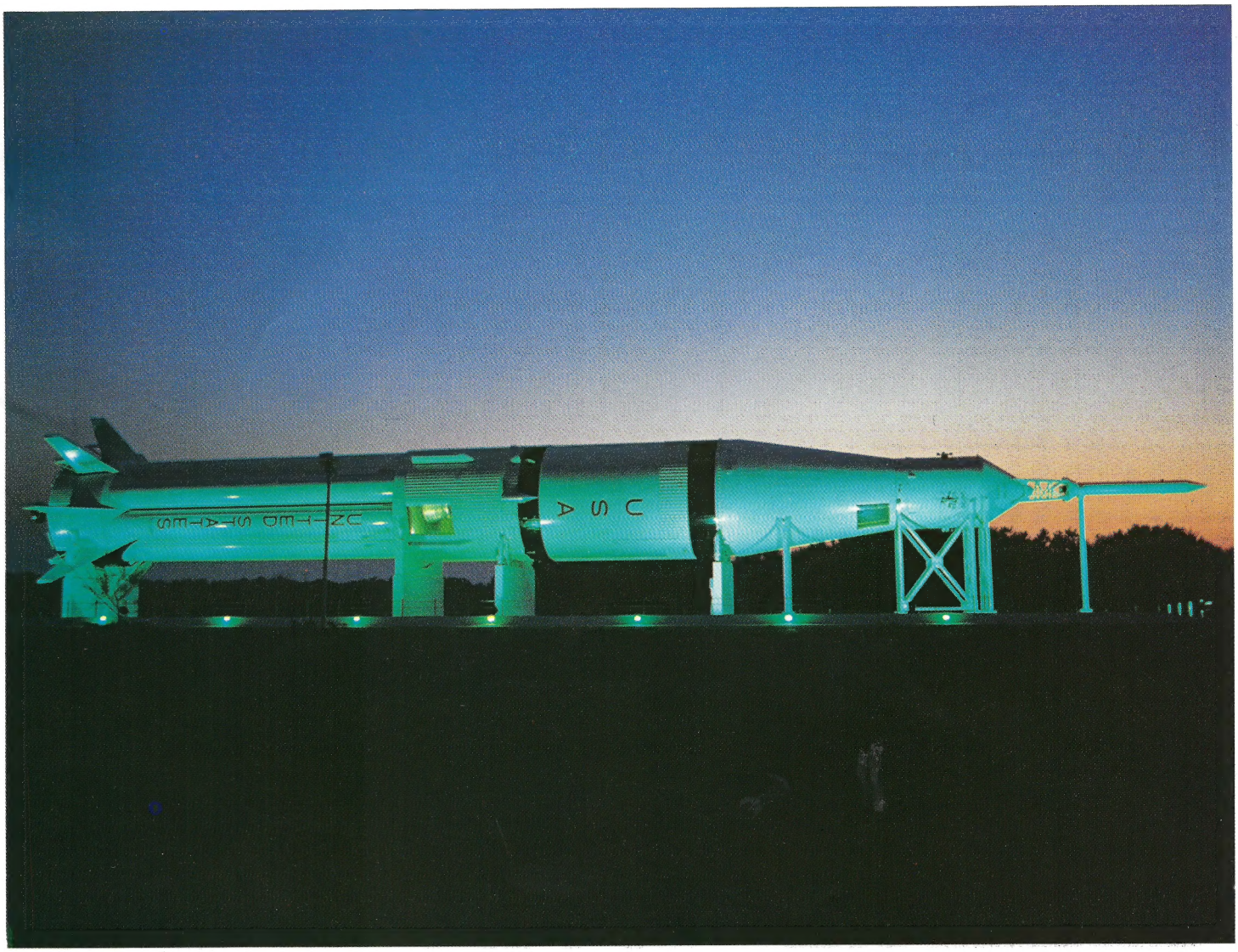
# Visitors Center



Spaceman and visitors pose in front of a full-size Lunar Module mock-up.



At the Visitors Center, rockets and engines for space mix easily with the subtropical plants of Florida.



Actual Saturn 1B Rocket like those used in the first manned Apollo launch and the three visits to the Skylab orbiting station.

# Visitors Center

Your first view of the Visitors Center reveals an impressive display of historic rockets.

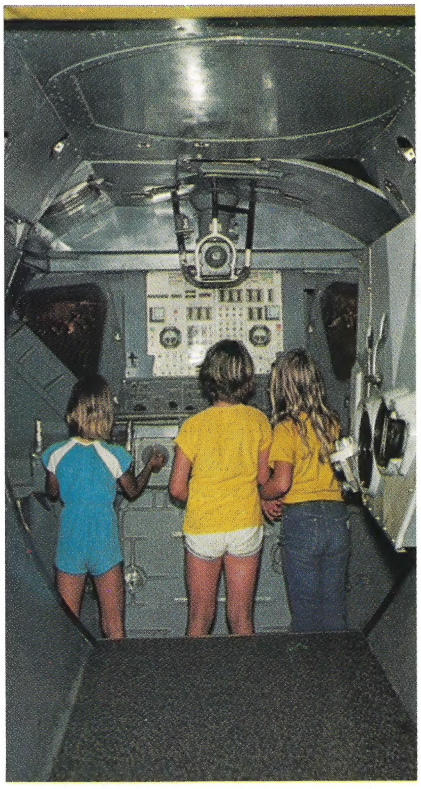
Monument — "In Memory of those who in the line of duty have given their lives to Space Exploration."

History and the future are blended together in this handpainted acrylic mural depicting United States Space Exploration.

Comsat — Helping to link the nations together with communication via satellite.

# Visitors Center

Suit up for your photo album

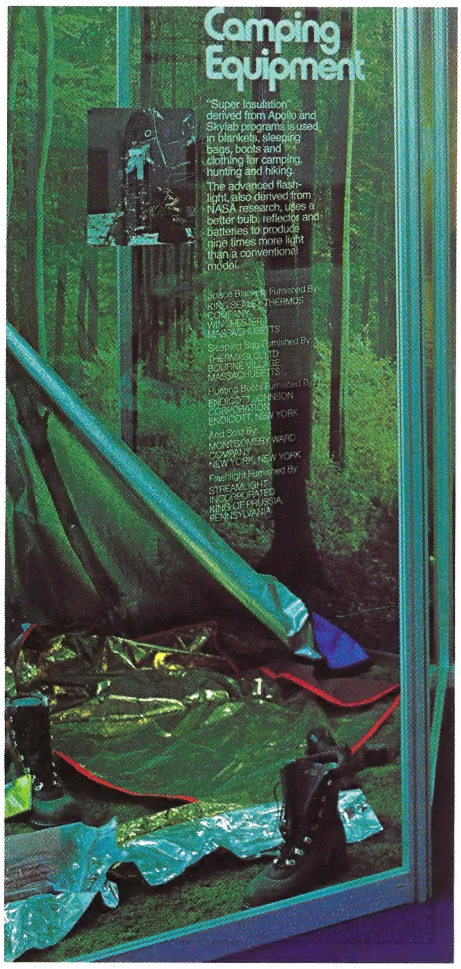


Like it really was — inside the Lunar Module

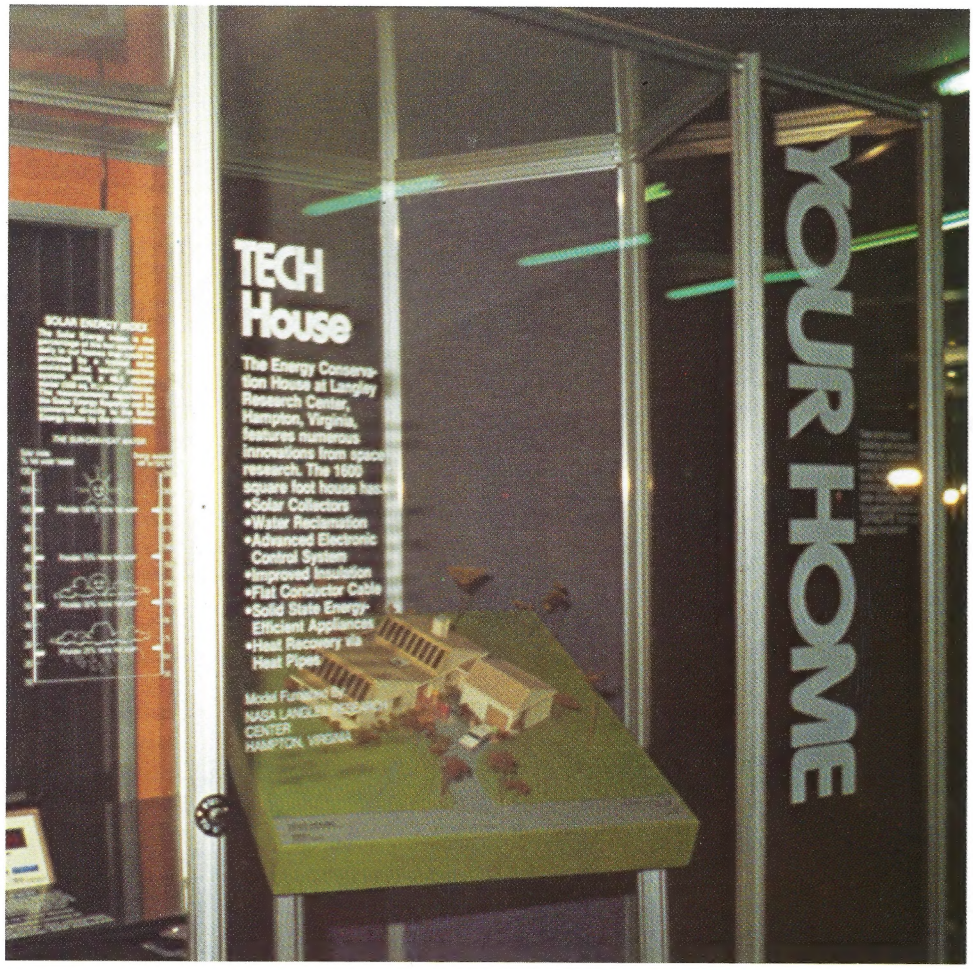
Sit on a Lunar Rover — Imagine being on the Moon

Attend free Aerospace Demonstrations, presented live, throughout the day, in Theater One.

# Spinoffs


Camping Equipment
"Super Insulation" derived from Apollo and Skylab programs is used in blankets, sleeping bags, boots and clothing for camping, hunting and hiking.
The advanced flashlight, also derived from NASA research, uses a better bulb, reflector and batteries to produce nine times more light than a conventional model.

New type camping equipment — from developments in space technology.


TECH House
The Energy Conservation House at Langley Research Center, Hampton, Virginia, features numerous innovations from space research. The 1600 square foot house has:
•Solar Collectors
•Water Reclamation
•Advanced Electronic Control System
•Improved Insulation
•Flat Conductor Cable
•Solid State Energy-Efficient Appliances
•Heat Recovery via Heat Pipes
YOUR HOME

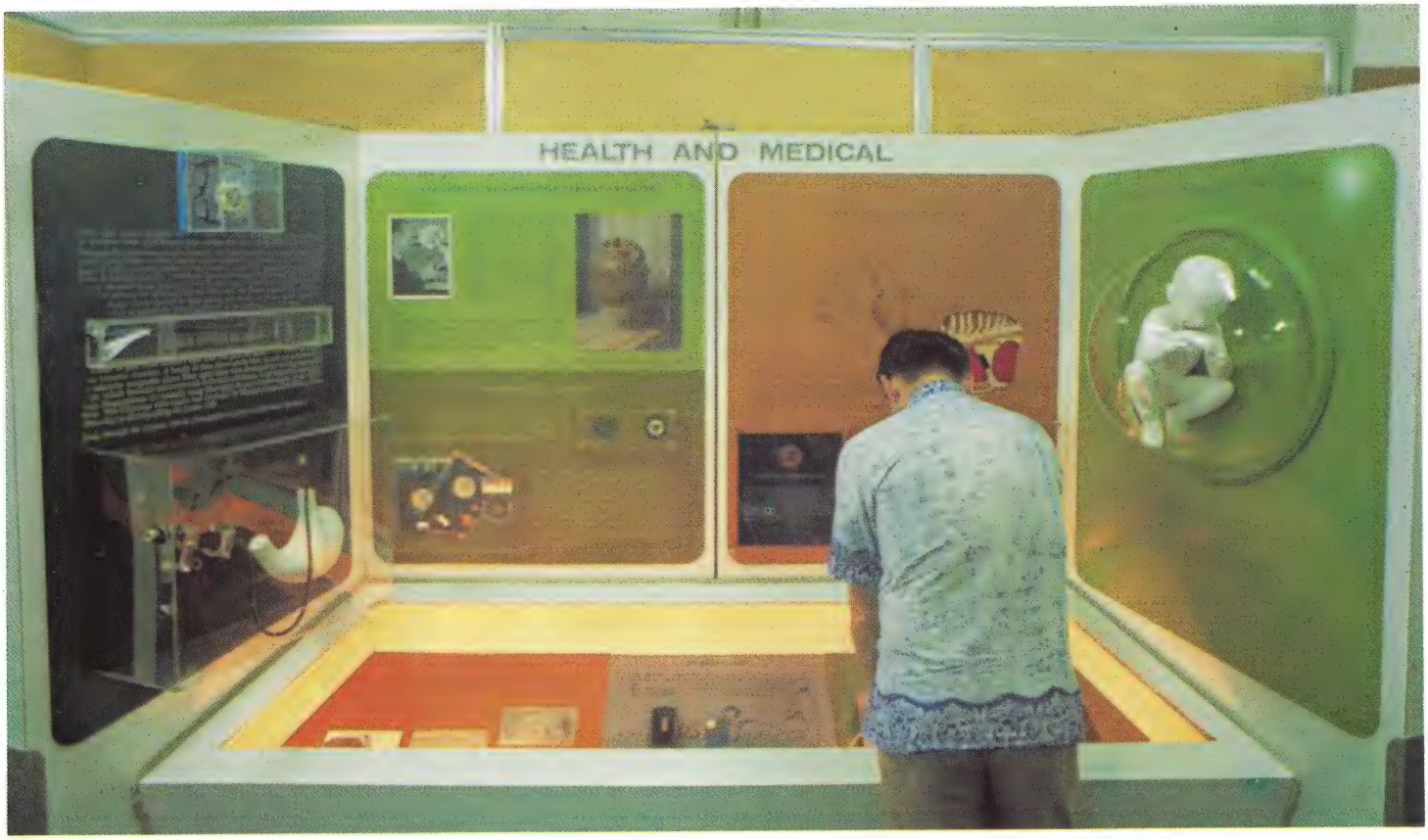
The home of the future — better living through using innovations from space research.

Recreational equipment made from materials used in rockets and spacecraft is safer and longer lasting.

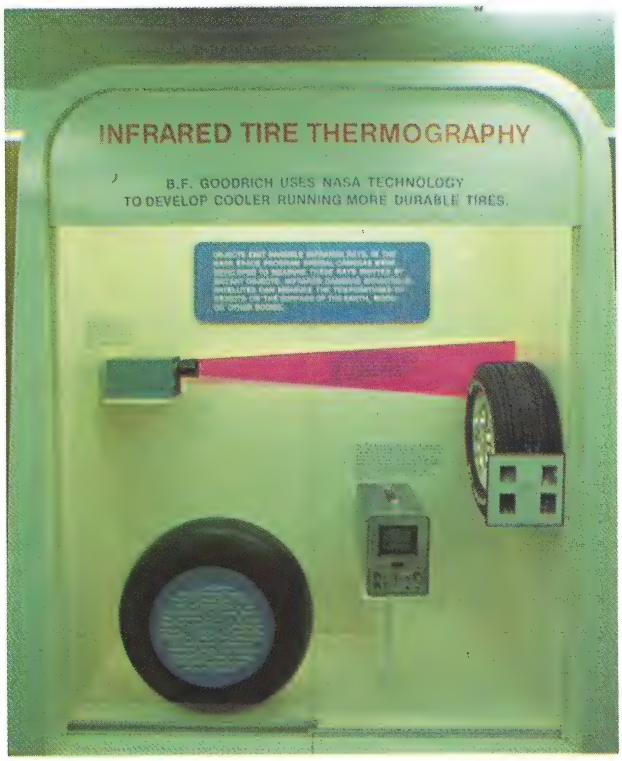
Fire Safety
Spacesuit and life support technology have led to development of improved breathing system and clothing for firefighters. A better short-range radio for on NASA communications research is under development.
Fire Rescue Pack
Backpack Resuscitator
A commercially available unit used by medical rescue and fire fighting personnel. This equipment has aspiration and resuscitation capabilities, but is large, heavy, and is not oxygen compatible.
KSC Mini Resuscitator Type II
Improved resuscitator developed at KSC for use by fire and medical rescue personnel. This improved lightweight unit has both aspiration and resuscitation capabilities and also is oxygen compatible.

Today, new improved fire safety equipment and wearing apparel developed by Kennedy Space Center engineers are now being used and tested by firefighters and medical rescue units in various parts of the nation.

# Spinoffs




Spinoffs in the field of health and medicine have been outstanding. The rechargeable pacemaker, now being worn by thousands of heart patients, was developed directly from the technology of the space program.




Infrared tire thermography — a leading tire manufacturer is now using NASA technology to develop cooler running, more durable tires for vehicles of all sizes.

New type surgical implants made from materials developed for applications in the unique space environment may aid handicapped persons.

# Hall of History

Hall of History — a very unique display that covers a wide variety of space achievements. In this building you can view and photograph a real Moon rock, spacecraft that have been in space and returned, spacesuits worn by astronauts, and many models of unmanned spacecraft launched by NASA. Exhibits of all kinds make the Hall of History a "must" to see at the Visitors Center.

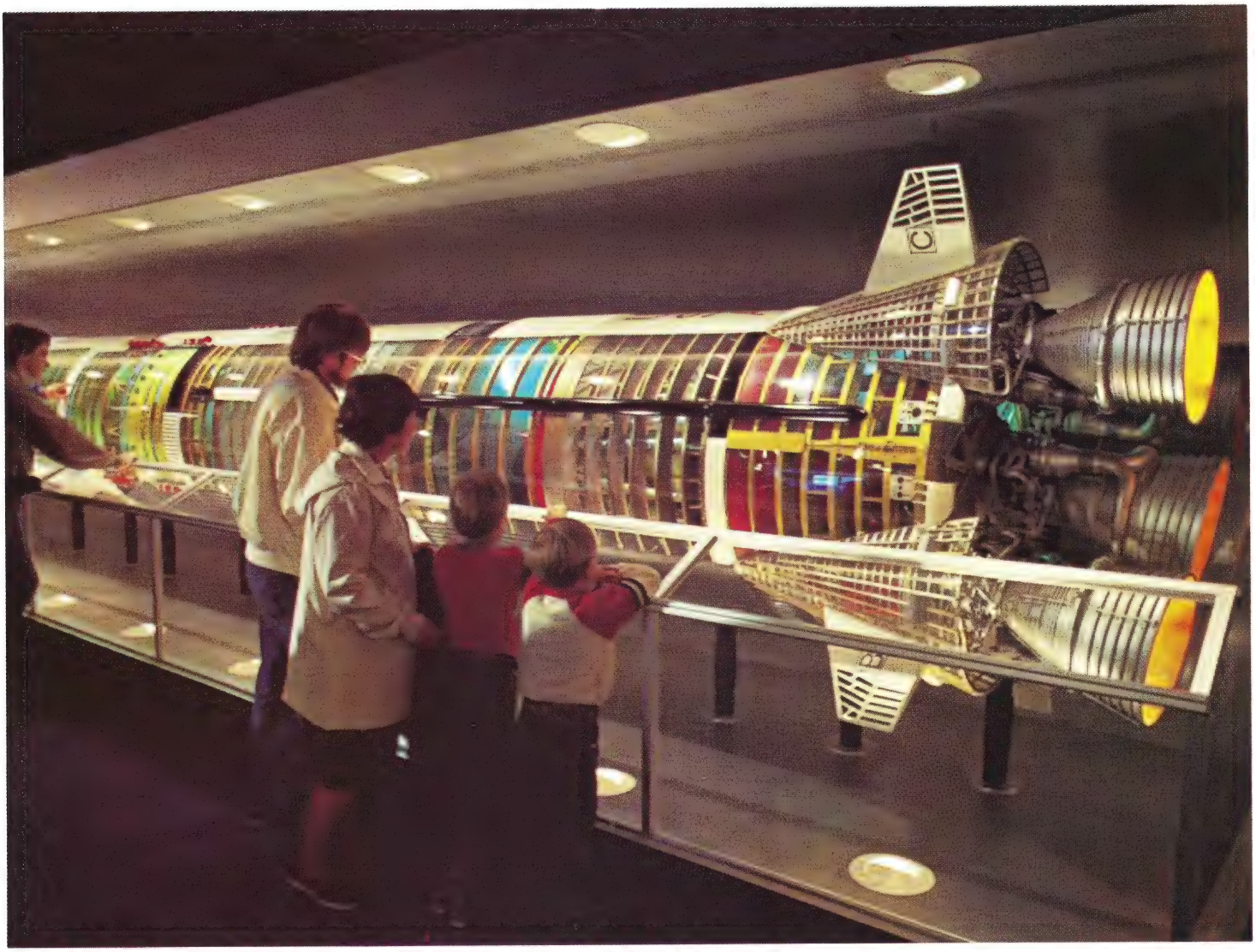
Rockets
For centuries, people watched birds in the sky and dreamed of flying. But wings can't carry us beyond the limit of the atmosphere. To travel into space, we need a different kind of vehicle: the rocket.

A scale model of the 111 meter (363 foot) tall Saturn V rocket topped by the Apollo spacecraft stands in the center of a group of other models to show the development of American rocketry.

# Hall of History

Gemini Space Suit worn by Astronaut David Scott on the Gemini 8 mission in March 1966.

Actual Apollo spacecraft that docked with the Russian Soyuz spacecraft during a historic cooperative space flight in 1975.



This one-tenth scale model of the Saturn V Moon Rocket and Apollo spacecraft is cut away to show the inner workings of this famous space vehicle.

# Hall of History

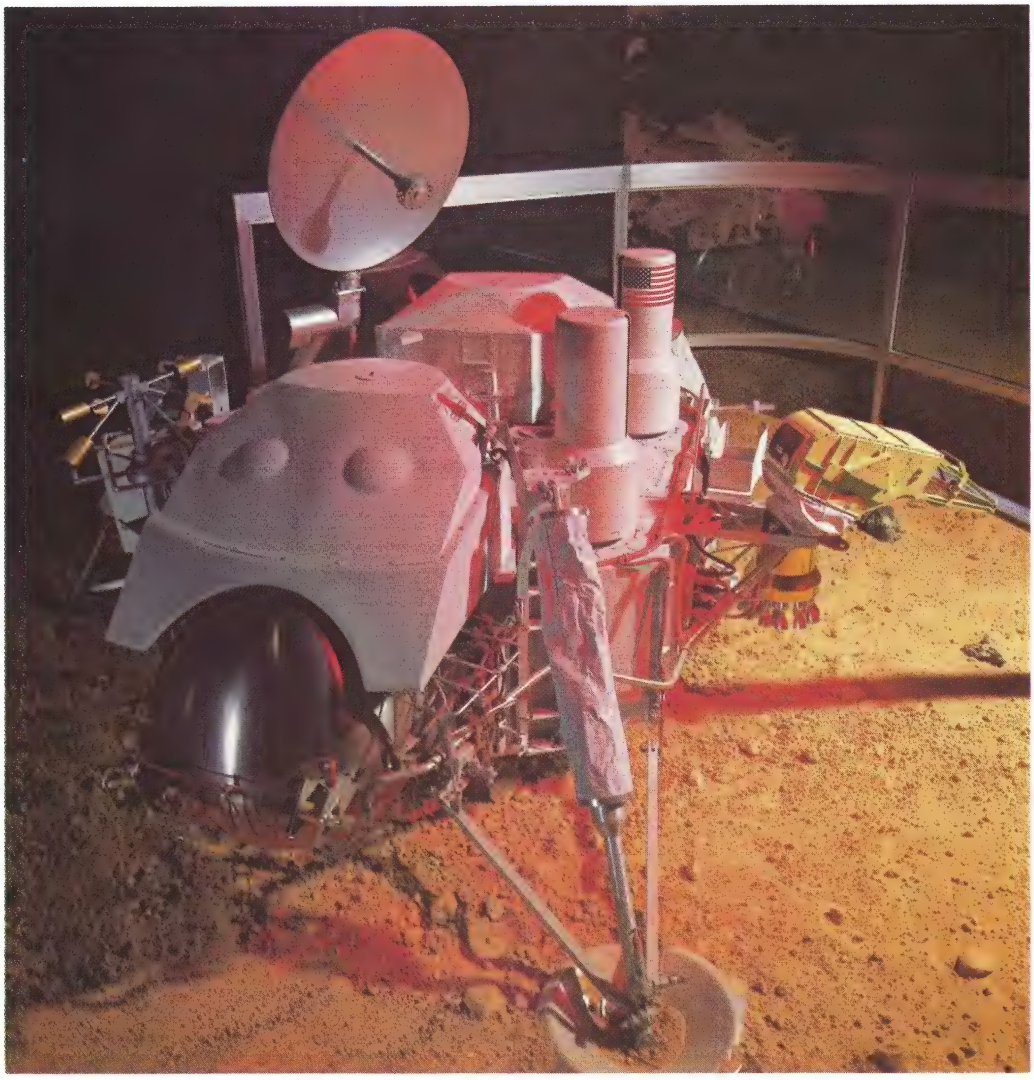
"One Small Step for a Man, One Giant Leap for Mankind" — Apollo 11, July 20, 1969

Display of colorful mission emblems used in the Apollo Lunar Landing Program. Each emblem tells a story of its own.

Full size model of a Lunar Rover.

# Hall of History

Just like walking through space



Full size detailed model of the Viking Mars Lander. In 1976 two spacecraft landed on Mars, the Red Planet, to gather important information about the surface and the atmosphere.

# Souvenir Shop & Carousel Cafeteria

Be sure to visit the Souvenir Shop, adjacent to the Visitors Center's main building. You will find many remembrances of U.S. space flights and ample "necessities" for young astronauts. An exciting array of gift items from model rockets to astronaut flight suits is available, including pictures of space flights, rockets, astronauts, the earth, the moon, and slide series that depict specific missions of NASA. Souvenir pencils, pens, banners and coins are also available. If you like to put models together this is an ideal place for model builders. Many are available and complete instructions are included in every box.

The giant wheel in the Carousel Cafeteria continually moves to place delicious foods right at your finger tips. You can plan an entire meal, a small snack, add scrumptious desserts and top off with your favorite hot or cold beverage. There is plenty of seating inside the Cafeteria, but you may enjoy eating your meal on our outdoor screened patio. Whatever your choice, you need not be hungry while you visit with us at the Kennedy Space Center.

# Kennedy Space Center Tour Part 1

This is where your tour begins . . . At this nation's major launch base for all manned and most unmanned spacecraft. America's Spaceport is operated by NASA — the National Aeronautics and Space Administration (a civilian agency of the government.)

On your tour you will be able to see some of the launch facilities used in NASA's exploration of outer space.

This is where the efforts of thousands of people from all walks of life have been brought together to achieve this nation's goals in space exploration. Space activity, over the years, has generated worldwide interest. We hope that after you have seen our facilities and have heard our story you will have a much better understanding of what we are really trying to do in space — that is, to benefit mankind, on Earth.

Public bus tours of the Spaceport began in 1966. There are times when operational requirements make it necessary to change the tour route or in some cases close the Center to the public.

Our courteous driver-escorts have many years of experience behind them. They are proud possessors of high safety awards for their driving records.

The Central Instrumentation Facility is filled with space-age computers. All pre-flight and launch data of NASA's unmanned space vehicles is fed from launch pads to these computers. The computers provide a printed, tape-recorded or TV display for use in analyzing rocket and spacecraft performance. Also in this building are located the laboratories and workshops where some 24,000 pieces of delicate test equipment are calibrated or repaired in support of launch activities.

The Communications Distribution and Switching Center, a vital part of Space Center operations, uses a huge dish-shaped radio antenna as a communications link by satellite between the Kennedy Space Center, Mission Control in Houston, Texas, NASA Headquarters in Washington, D.C. and other NASA Centers. The antenna dish, constructed entirely of aluminum, is 11 meters (35 feet) in diameter, and parabolic in shape. Since the relay satellite is essentially stationary in orbit, the antenna is also fixed in place and doesn't require a complicated tracking system.

# Kennedy Space Center Tour Part 1

The Headquarters Building is where the management offices are located for all operations underway at the Kennedy Space Center.

The Headquarters Building is the administrative center for all Spaceport activities. The director of the Kennedy Space Center and his deputy plus many of the management staff and several hundred contractor and support personnel work in the offices located throughout this large structure. This government-industry team consists of 2,300 federal employees and approximately 11,200 contractor employees representing a large number of American industrial firms.

Operations and Checkout Building

The Operations and Checkout Building is the largest in the industrial area. Here, spacecraft used for the Moon landing missions, as well as Skylab and the joint mission with the Soviet Union in 1975 were prepared for launch. In this same building Spacelab, which is the European Space Agency's contribution to the Space Shuttle program, is checked out prior to launch in the cargo bay of the Shuttle Orbiter.

The taller section, at the rear, is where Spacelab and other Space Shuttle payloads are assembled and checked out.

When astronaut crews are assigned here for an upcoming mission, they occupy living quarters on the third floor.

# Kennedy Space Center Tour Part 2

Flight Crew Training Building

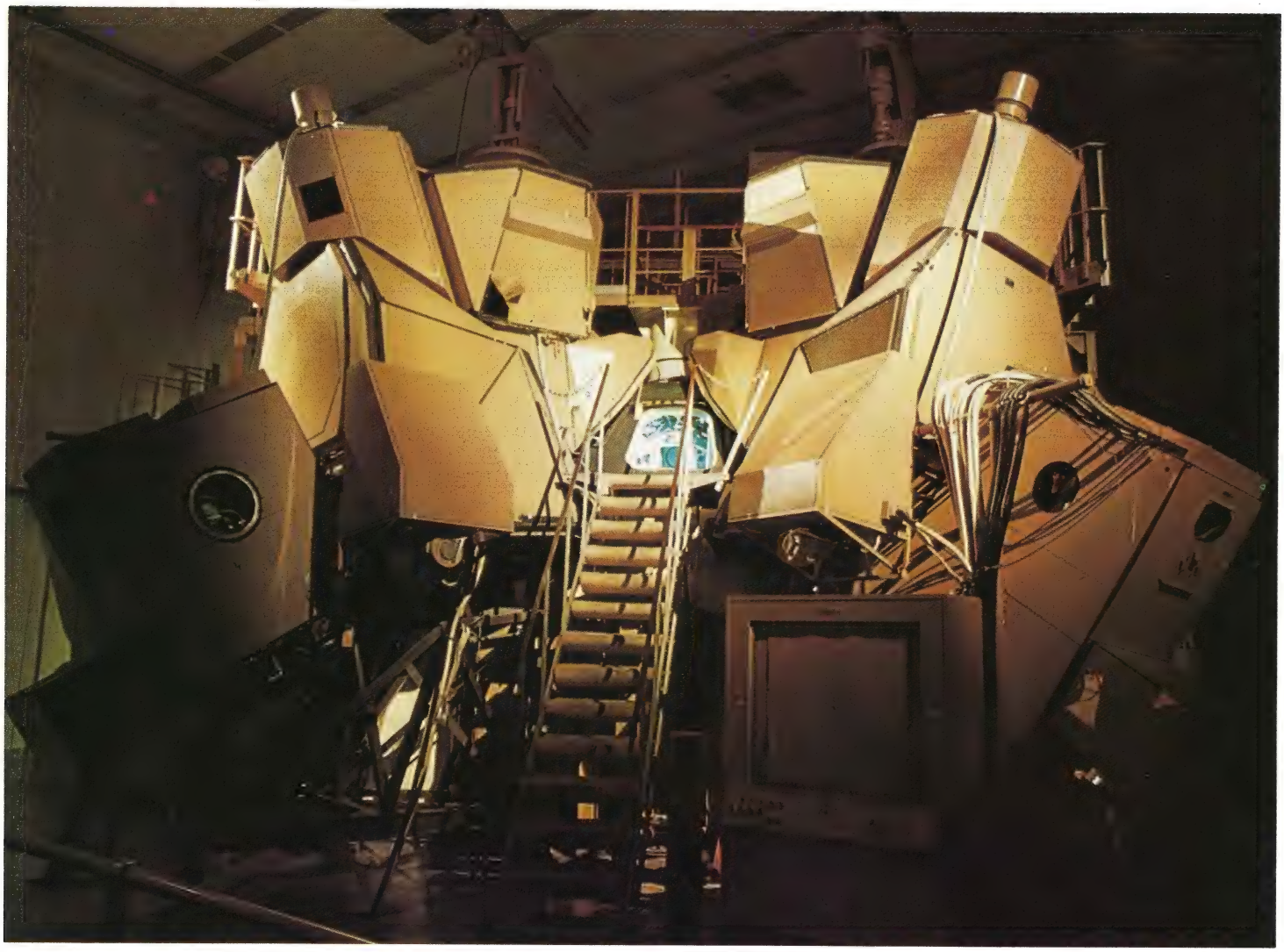
The Flight Crew Training Building was the focal point in the training of astronaut crews for their flights to the Moon and return to Earth. Inside the building are very complex and large machines called simulators which enabled the astronauts to rehearse every detail of their flights to and from the Moon. The crews in training here communicated with their flight controllers in Houston, Texas as they would during an actual flight. Simulated problems would be fed into the computers for training purposes. When the astronauts emerged from training in these machines they were ready for the real flight.

Today most of this facility is used by engineers and technicians who work on the sophisticated Launch Processing System used to checkout and launch this nation's newest spaceship, the Space Shuttle.

The most knowledgeable engineers trained the astronauts for their flight. Not just hours, but months of training went into every moment of an actual flight. Scale models, movies, and video tape all helped to provide lifelike training for all Apollo astronauts.

Control console for the Apollo Command Module simulator. From this console engineers ran simulations to train astronauts for their missions.

# Kennedy Space Center Tour Part 2



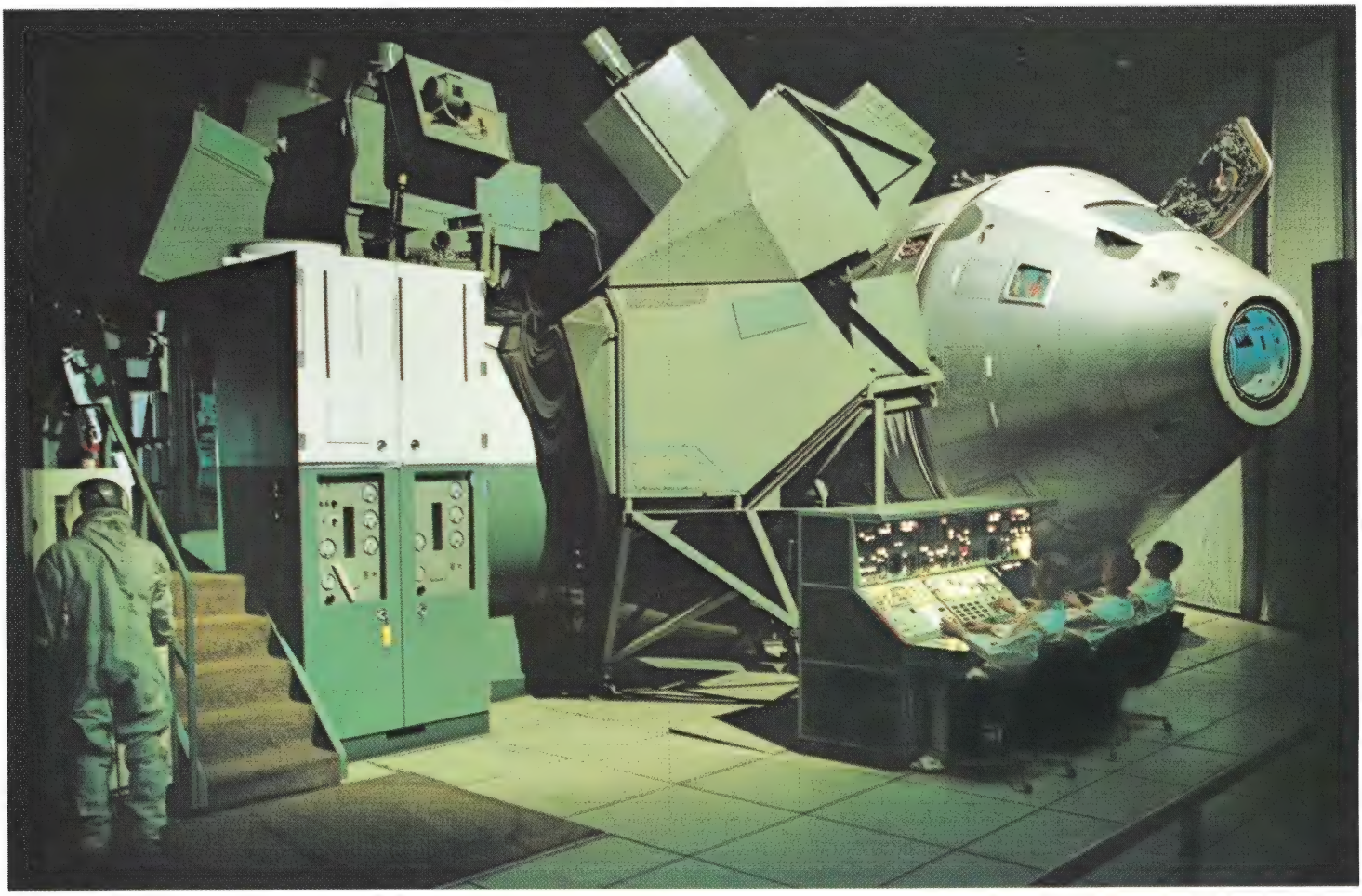
Command Module Simulator

The inside of the Command Module Simulator is an exact replica of the real Command Module . . . Once the hatch door is closed, anyone inside would believe they were in the real one sitting on top of the Saturn V rocket on the pad, ready to go.

From TV monitors placed in the windows they could see the Earth, Sun, Moon, stars just as they would appear during the flight. These pictures would change according to the flight trajectory. The entire mission was programmed on computer tape. Called the Mission Profile, it would go through every step of the pre-launch, launch, flight, Moon landing, take-off, return flight and final landing in the ocean. The astronauts displayed humor in demonstrating the simulators to distinguished foreign guests. For example, former West German Chancellor Willy Brandt found the familiar Volkswagen insignia awaiting him on the moon, and the late President Pompidou of France found that his descent trajectory carried him directly over the Eiffel Tower.

Scale model of Apolla 17 landing site.

# Kennedy Space Center Tour Part 2



Lunar Module Simulator

The Lunar Modules which carried six different crews of astronauts to the Moon's surface during the six successful Apollo expeditions, were marvels of engineering. The Lunar Module stood nearly 7 meters (23 feet) tall and measured 9.2 meters (30 feet) diagonally across the legs. The Lunar Module you see pictured on the next page is not a model, but an operational vehicle capable of flight. The descent stage of the Lunar Module supplied the power for the trip down to the lunar surface and served as a launch pad for the ascent stage. The ascent stage carried the crew back up to rendevous and dock with the command ship as it circled in lunar orbit. Fully fueled, the Lunar Module weighed over 16 metric tons (36,000 pounds). While on the Moon, the Lunar Module served as home base for the astronauts. Each of the six crews erected American flags.

While on the Moon two of our astronauts, David Scott and Jack Schmitt, expressed personal thoughts about the Apollo journeys to the Moon. David Scott said, as he stood among the wonders of the unknown at Hadley Rille: "I realized that there is a fundamental truth to our nature. Man must explore, and this is exploration at its greatest."

Apollo Command Module with door in open position

# Kennedy Space Center Tour Part 2

Simulated Lunar Landing Site

This is a real Lunar Module. You can see the hatchway from which the two space explorers emerged to step on the surface of the Moon.

The Lunar Rover is carried in the lower section of the Lunar Module. Once on the surface and ready to go, it could travel a total of nearly 64 kilometers (40 miles) at speeds up to 16 kph (10 mph).

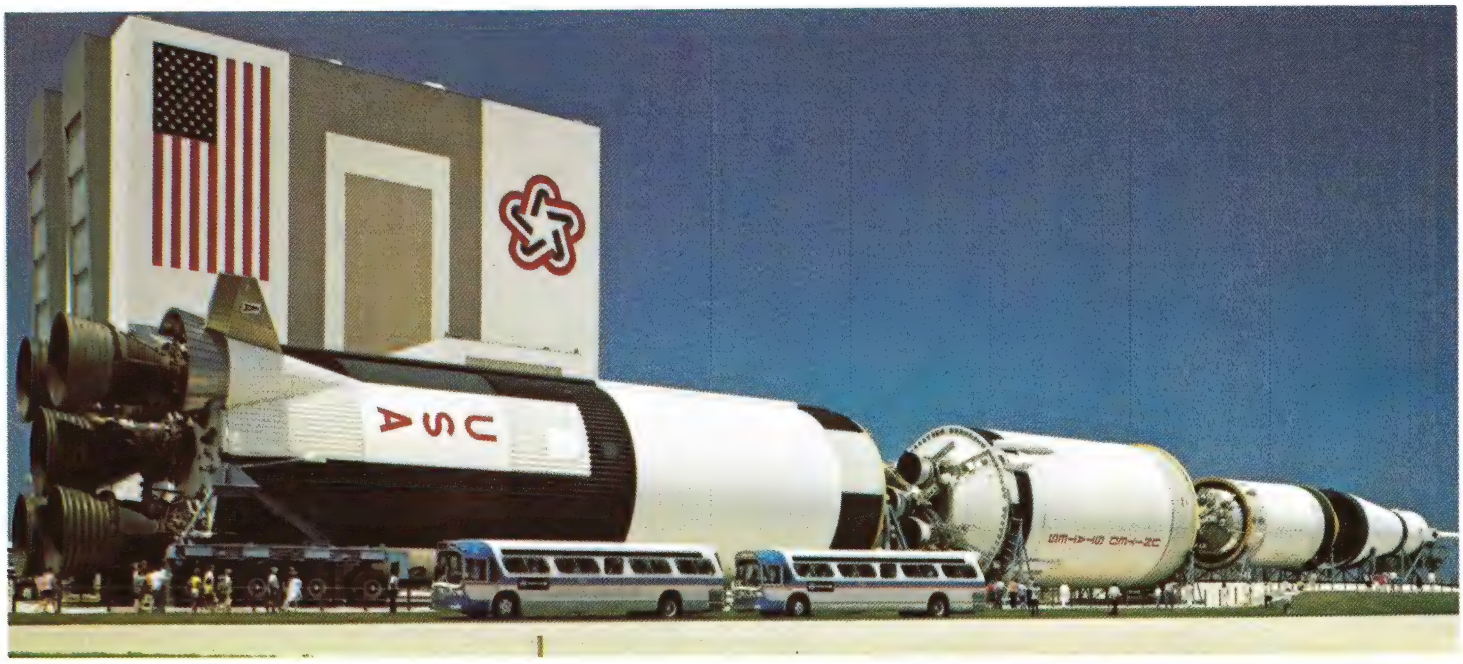
# Kennedy Space Center Tour Part 3

Vehicle Assembly Building — where Space Shuttles are assembled and tested before launch.

Dominating the landscape at the Kennedy Space Center is the Vehicle Assembly Building, standing 160 meters (525 feet) and covering over 3 hectares (8 acres) of ground. The inside volume of over 3.6 million cubic meters (129 million cubic feet) makes it one of the world's largest enclosed structures.

Visitors, as well as employees of the Kennedy Space Center, are no longer permitted inside unless they have a working need to be there. Space Shuttle solid rocket boosters are now stored inside. They are filled with propellants that, even though the probability is very low, could ignite if they came in contact with extreme heat.

Next to the Vehicle Assembly Building is the Launch Control Center, the actual nerve center at Complex 39. Managers, engineers and technicians are stationed here during the launch activity and the consoles are manned by experienced personnel.



A Saturn V Moon rocket on display near the Vehicle Assembly Building

Mobile Launcher used to launch the Saturn 1 B rocket in the Skylab and Apollo-Soyuz space missions.

Above you see an actual Saturn V rocket, separated at its sectional points to allow a good view of the engines for each stage of the rocket. Standing vertically, the rocket and spacecraft towered 111 meters (363 feet) and weighed 2,812 metric tons (6.2 million pounds).

To the left is one of several mobile launchers used at Complex 39. They actually hold the rocket in place during its journey from the VAB to the launch pad and on the pad during the launch. The mobile launcher is positioned on six steel pedestals when in the VAB or at the pad. Two of the three mobile launchers here have been modified for use in the Space Shuttle program.

# Kennedy Space Center Tour Part 4

A Space Shuttle begins its journey to the launch pad.

The crawlerway is a specially constructed roadway designed to support the tremendous loads of transporter and Shuttle while it travels from the Vehicle Assembly Building to the launch pad. The river rock surface covers a layer of asphalt and a two meter (7 foot) bed of crushed stone. The distance from the VAB to the pad is 5.6 kilometers (3.5 miles).

# Kennedy Space Center Tour Part 4

The Crawler Transporter you see here is one of two at the Kennedy Space Center and is a very special machine. They are used to move space vehicles to the launch pad. A transporter can lift and carry 6,590,909 kg (14,500,000 pounds).

Each Transporter is about half the size of a soccer field and weighs over 2,700 metric tons (6 million pounds). Propulsion is provided by two powerful diesel electric generators. The generators, in turn, power electric motors which turn the treads.

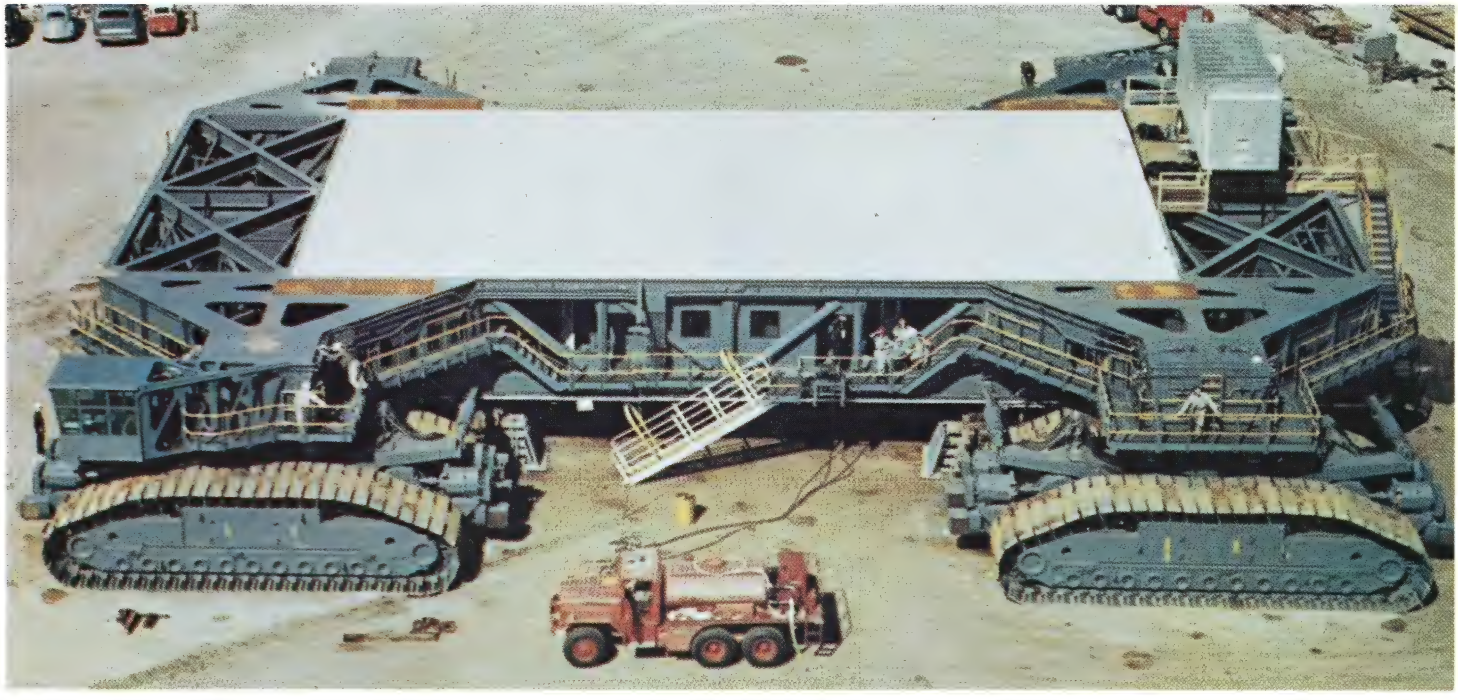
Normal speed of the transporter is 1.6 kilometers per hour (1 mph) when it has a load on top, but without a load it moves along rather quickly — 3.2 kilometers per hour (2 mph).

A hydraulic system can vary the transporter's height at either or both ends by as much as two meters (6 feet); thus, the transporter's towering load can be kept level while underway and as it slowly moves up the incline at the launch pad. The transporter requires a crew of 26. The driver sits in a glass-enclosed cab facing the direction of travel.

Two cleats from the track of a Crawler Transporter, pictured at upper right, make a popular and impressive display at the Visitors Center. Each cleat weighs 907 kilograms (one ton). Each of the eight tracks on the Transporter has 57 cleats or a total of 456 cleats for a grand total of 413,592 kilograms (912 tons) of solid steel. The pins which connect the tracks weigh about 45.5 kilograms (100 lb.) each.

In 1977 the American Society of Mechanical Engineers designated the Transporters of Launch Complex 39 as a "National Historic Mechanical Engineering Landmark."

The two cleats are topped off with a 1/48 scale model of a Crawler Transporter.



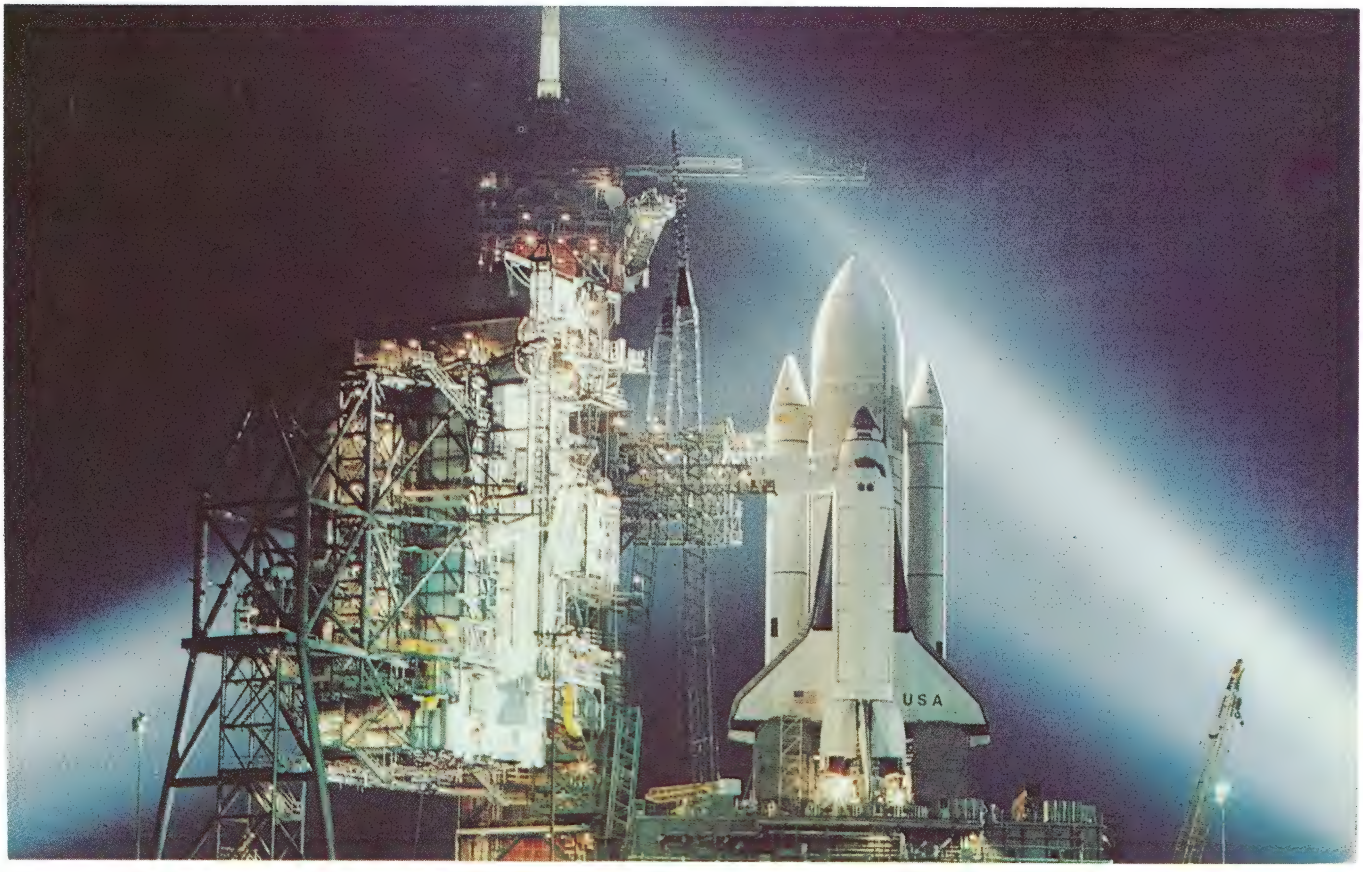
Crawler Transporter

# Kennedy Space Center Tour Part 5

Shuttle on Pad A at Complex 39, during a test of the water sound suppression system.

The launch pad is constructed of 52,000 cubic meters (68,000 cubic yards) of reinforced concrete. On top of the pad are six steel pedestals used to support the launch platform and the spacecraft. Nearby are two service towers. The tallest one is in a fixed position, and the shorter one is mounted on wheels so that it can swing away from the rocket. These towers provide access to the rocket for astronaut boarding, payload installation, fueling and final checkout before launch.

During the actual launch, water spouts located in the flame trench and on the mobile launch platform will dump over 1.1 million liters (300,000 gallons) of water onto the pad area during a 20-second period to provide sound suppression and cooling.



Night-time brings a special glow to the Shuttle.

# Kennedy Space Center Tour Part 5

Visitors get a good view of the Space Shuttle on the launch pad.

Scoreboard of space flights to refresh your memory.

When the Shuttle is on the launch pad, it is sometimes possible for our visitors to see and photograph the vehicle as it waits to be launched.

NASA and the aerospace industry have developed this revolutionary new transportation system for routine operations in space. With its versatility and reusability, the Space Shuttle truly opens the door to the economical use of space. The economy of Shuttle operations will encourage more nations and private industries to participate in many space ventures, since it will bring the cost within their reach. Joint experiments and enterprises will help make the benefits of space exploration and technology more widely available to millions of people around the world.

Europe is already a major partner in the Shuttle. Ten nations of the European Space Agency are designing, funding and building "Spacelab" which is a versatile and reusable flight unit carried in the huge cargo bay of the Orbiter. Austria, Belgium, Denmark, France, Germany, Italy, Holland, Spain, Switzerland and the United Kingdom all share in the operations of Spacelab, with the United States. Canada is providing the 15.2 meter (50 foot) remote manipulator arm which will deploy and retrieve payloads in space.

The Shuttle Era begins just over 20 years after the first American satellite in space, the "Explorer I" in 1958.

This historic area has been transformed into the place from where the Space Shuttle will venture into Earth orbit, enabling us to capitalize on knowledge gained from all previous space programs.

# Kennedy Space Center Tour Part 6

The Vehicle Assembly Building and the Shuttle Landing Facility where the Orbiter lands after a mission in space.

The Vehicle Assembly Building is one of the world's largest structures in volume, enclosing about 3,664,833 cubic meters (129,428,000 cubic feet).

It is here that the Space Shuttle components are assembled into a flight-ready space vehicle before being taken to the launch pad.

Once inside the Vehicle Assembly Building, huge cranes lift the Orbiter Columbia to the top of the building, then slowly across the aisle into the selected bay where the Mobile Launcher awaits. This assembly process actually takes many hours as the cranes slowly move across the building.

The first time that the Space Shuttle Orbiter Columbia was moved the 275 meters (300 yards) from the Orbiter Processing Facility to the Vehicle Assembly Building was on November 24, 1980. The 68,000 kg (75 ton) Spaceship was hoisted into an assembly bay and mated with other Space Shuttle elements on a Mobile Launch Platform.

Huge cranes lift the different parts of the vehicle from the large center aisle and then move them vertically, very carefully, into assembly areas or bays. There the parts are lowered to the Mobile Launcher and attached to one another until the final configuration is complete. Many more checks are made before the Crawler Transporter moves the tremendous load out to the launch site.

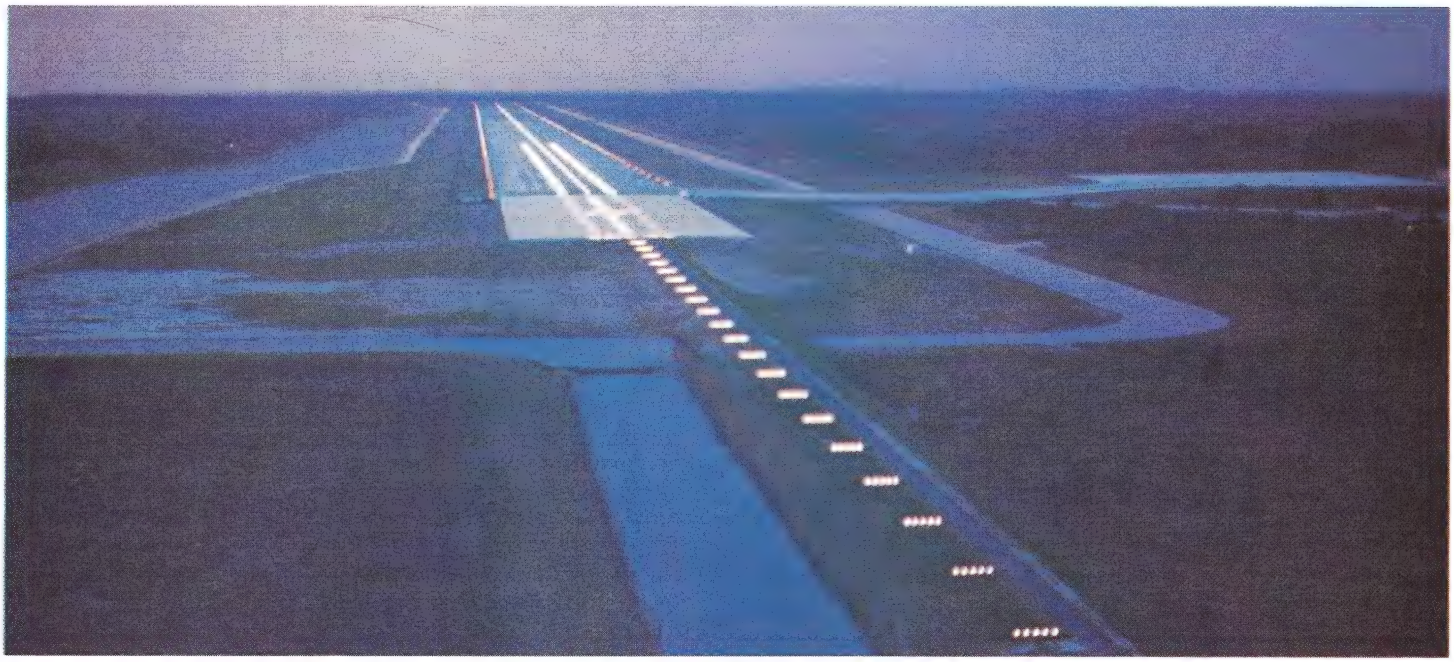
The Shuttle Landing Facility, seen in the upper left of the picture, is 4,572 meters (15,000 feet) long and 91.4 meters (300 feet) wide. It has 305 meters (1,000 feet) of paved overruns at each end. The paving thickness is 40.6 cm (16 inches). The landing strip includes a 150 x 168 meter (490 x 550 foot) parking apron and a 3.2 km (2 mile) tow-way road connecting it with the Orbiter Processing Facility where the Orbiter is prepared before being taken into the Vehicle Assembly Building.

# Kennedy Space Center Tour Part 7

Shuttle Orbiter on its way to the Vehicle Assembly Building

Space Shuttle Columbia moves out of the Orbiter Processing Facility

# Kennedy Space Center Tour Part 8



Night-time view of runway at KSC

The most modern landing system ever devised is used to guide the Orbiter to its touchdown point on this runway.

Automatic guidance is initiated at a point where the Orbiter has a very sharp angle of entry, over seven times that of a commercial aircraft approach. The descent rate is greater than 3,048 meters (10,000 feet) per minute — approximately 20 times that of a commercial airliner.

At about 533 meters (1,750 foot) altitude, the flight crew deploys the landing gear.

The Orbiter can be guided and landed automatically by onboard computers. If there is any variation, the crew can take over at any time for a manually controlled landing.

Inside the Mate-Demate Device, the Orbiter Columbia is off-loaded from NASA's 747 jet transport. Demate crews work through the night uncoupling the Orbiter from its carrier. The Orbiter, riding piggyback aboard the 747, was carried 3,800 km (2,400 miles) from the Dryden Flight Research Center, California to the Kennedy Space Center.

# Special Launch Tours

Air-conditioned buses are lined up at viewing site after unloading passengers on Launch Tours.

Thousands of visitors view a launch from Cape Canaveral Air Force Station.

The launch of a rocket at night brings a special thrill. Suddenly the darkness and stillness of the evening hours are shattered by a roar of engines and the brilliance of firepower as the rocket and spacecraft blast off for another delivery into space. The sound and light leave behind a trailing white plume, marking the quickly traveled flight path.

# Expendable Rockets
## Unmanned Launches

A Delta rocket soars skyward from Complex 17 on Cape Canaveral Air Force Station to place a Geostationary Operational Environmental Satellite (GOES) in an orbit above the Earth's equator. From this lofty perch, over the nation of Colombia, the satellite will monitor weather conditions over the eastern halves of the United States and Canada, all of Central and South America, and much of the Atlantic Ocean.

Final servicing before encapsulation is performed by technicians on the weather satellite. When covered and tested, the spacecraft will be mounted atop the rocket for launch. Meteorological satellites provide continuous weather data, so important to our everyday lives. Weather pictures are received every thirty minutes day and night and distributed from the Earth receiving stations to weather bureaus across the nation.

# Expendable Rockets
## Unmanned Launches

Atlas Centaur blasts away from Earth.

A powerful Atlas Centaur rocket leaves the launch pad on May 23, 1981 carrying an Intelsat V commercial communications satellite. This was the second in a series of nine of the high capacity spacecraft launched by NASA for Intelsat. The spacecraft is now positioned over the Atlantic Ocean. It is the largest and highest capacity communications satellite ever built. Twelve thousand two-way telephone calls and two color TV channels can be transmitted between two distant points at the same time.

Intelsat Communications Satellite

The launch capsule is closed around the Intelsat satellite in the explosive-safe area at the Cape Canaveral Air Force Station. The Intelsat satellites are launched on an Atlas Centaur launch vehicle from Pad 36 on the Cape.

# Wildlife

The Kennedy Space Center is located on Merritt Island, in Brevard County, Florida. Most of the land area of the Center is a national wildlife refuge where nature lives in harmony with rockets and spacecraft of this nation's space program.

The majestic American Bald Eagle, the national emblem of the United States, is a resident bird species at the Kennedy Space Center. An eagle's nest is visible from the bus on the tour.

Wood Ibis

Green Heron

More than 200 species of birds make their home at the Kennedy Space Center. Glossy Ibis, White Ibis, common Egret, Snowy Egret, Coots and Louisiana Heron are pictured above.

An armadillo searches for food among the bushes near the Space Shuttle.

# Wildlife

The vast space reservation embraces some 56,600 hectares (140,000 acres) of land and water and protects more endangered species of birds, mammals and reptiles than any other area of the continental United States. All areas not in operational use are managed for NASA by the U.S. Department of the Interior as the Merritt Island National Wildlife Refuge and Canaveral National Seashore. Some portions of those areas are accessible to the public from the city of Titusville via Florida Routes 402 and 406. Bird watchers and camera fans find these areas especially attractive.

Brown Pelican with young at feeding time

Roseate Spoonbill and Louisiana Heron

Great Blue Heron

Alligators are a common sight at the Kennedy Space Center.

Black Footed Ferrets

# Behind the Scenes

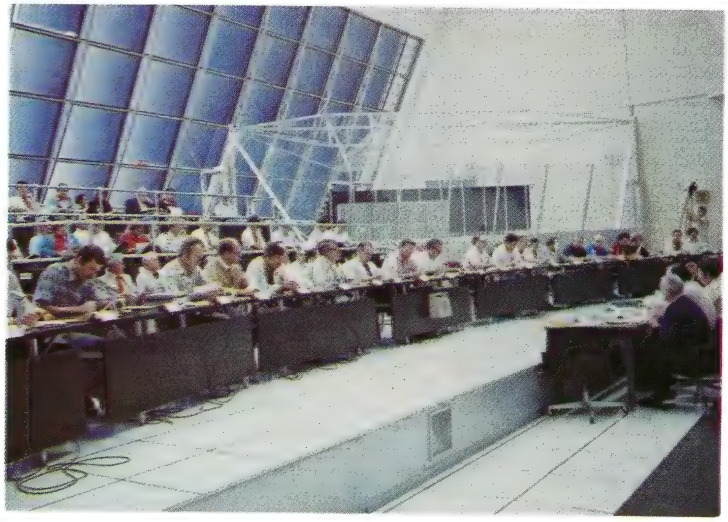
In the Operations and Checkout Building pieces of the European-built Spacelab are assembled, tested and readied for launch.

NASA management and contractor representatives meet in Firing Room #4 at the Launch Control Center, Launch Complex 39, to determine the readiness of the Space Shuttle for the flight readiness firing, a milestone test of the Orbiter's main propulsion engines and a dress rehearsal for the first Space Shuttle mission.

In this decade men and women of many nations who need to go into space to conduct important scientific and technical experiments will be provided that opportunity through Spacelab.

Spacelab development is financed by ten European nations under agreements with the European Space Agency.

Spacelab will be developed on a modular basis and carried in the cargo bay of the Orbiter to meet varying mission requirements. The two main components are the pressurized module which provides a laboratory with a shirt-sleeve working environment and the open pallet that exposes materials and equipment directly to space. Upon return to Earth, the module or pallet can be removed, refurbished and readied for another flight in a relatively short time.



Flight Readiness Review panel discusses progress of launch preparations during regularly held meetings in the Launch Control Center.

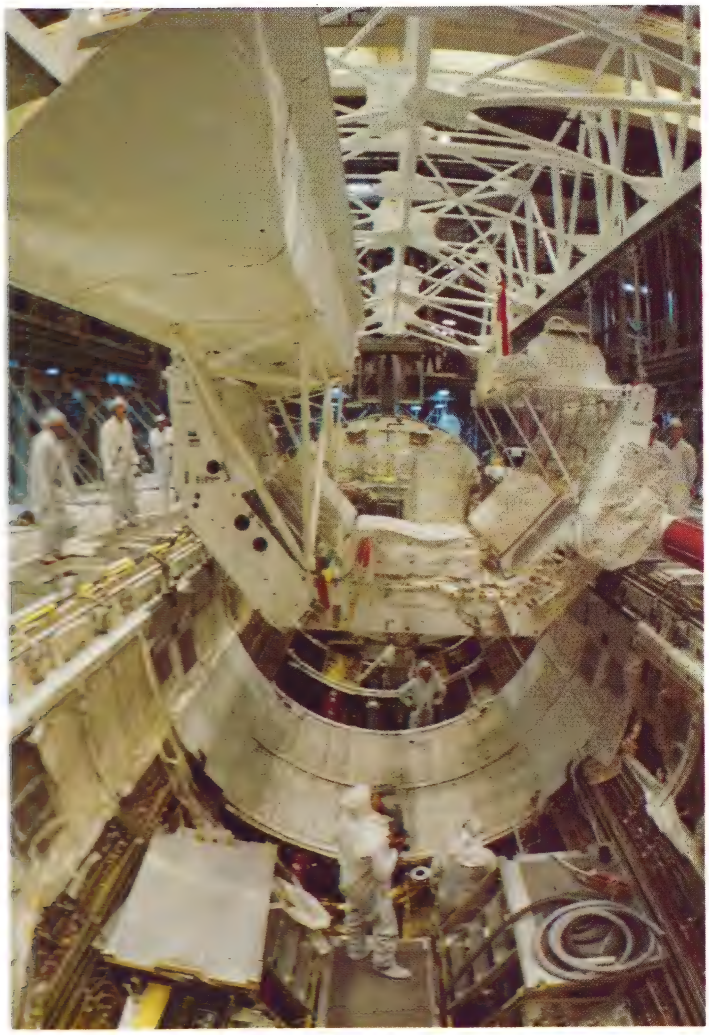
Astronauts Joe Engle and Richard Truly inspect the Remote Manipulator System in the Orbiter Processing Facility, as it undergoes preparation and installation in the cargo bay of Orbiter Columbia. The RMS, built in Canada, is designed to move orbital hardware from the cargo bay into space and, in future missions, help retrieve "spent" satellites and other space hardware from orbit.

Manipulator Arm

# Behind the Scenes

Space Shuttle launches are conducted by personnel manning these consoles in Firing Room 1, and from identical consoles in Firing Room 2. Firing Rooms 1 and 2 in the Launch Control Center have been equipped with the highly automated Launch Processing System, designed for Space Shuttle checkout and launch.

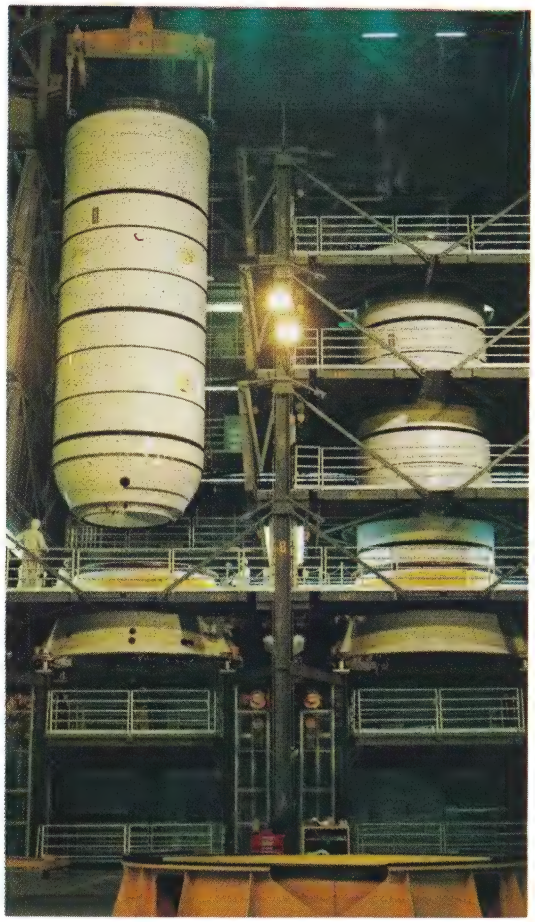
Firing Room — where countdown and launch decisions are made.



The Orbiter's cavernous cargo hold, with payload attachment points along its full length, is adaptable enough to accommodate as many as five unmanned spacecraft of various sizes and shapes on a single mission, including instruments that view Earth or outer space from within the hold when the doors are open, small self-contained experiments for a variety of users, or a fully equipped manned scientific laboratory. The Orbiter supplies them with electrical power, heating and cooling, data transmission or storage and displays for the payload specialists aboard, and communications with ground stations. For instruments that make their observations from platforms in the payload bay, the Orbiter's computers fire the small attitude-control thrusters to maintain pointing accuracy within half a degree.

OSTA-1, first Space Shuttle payload, with experiments for remote sensing of land resources, environmental quality, ocean conditions and meteorological phenomena.

# Behind the Scenes



The first solid rocket booster segments to arrive at KSC are off-loaded into High Bay 4 in the Vehicle Assembly Building and mated to their respective aft skirts. The two aft assemblies support the entire 45 meter (150 foot) tall boosters, in turn supporting the external tank and Orbiter Columbia on the mobile launcher platform for the first orbital flight test of the Space Shuttle.

Making a descent into the heart of the rocket segment (lower left), is a space worker inspecting the core of a live booster segment for cracks or other defects in the propellant grain.

Assembly of the first Space Shuttle was completed on November 26, 1980 with the mating of the Orbiter Columbia to its external tank in the Vehicle Assembly Building. Columbia, shown at lower right attached to its hoisting sling, was moved into the VAB on November 24, having completed tests and tile installation in the adjacent Orbiter Processing Facility. The other Shuttle components, the twin solid rocket boosters and the external propellant tank, were stacked on the mobile launcher platform a few months earlier.

"Stacking" the solid rocket booster segments in the Vehicle Assembly Building.

An engineer is lowered into the core of the solid rocket booster for inspection.

Mating Orbiter to external tank

# Behind the Scenes

Workers install thermal protection tiles on Space Shuttle Orbiter

Insulation tough enough to protect the Orbiter and its crew from the searing heat of repeated reentries had to be invented. In earlier manned spacecraft, thermal buildup was controlled by shedding glowing bits of the heat shield itself. But NASA asked for materials that would last through 100 missions before replacement, and effective enough to protect the aluminum substructure beneath for 500 missions. The answer was a special tile-like insulation that reflects away heat so effectively that when one side is cool enough to hold in your bare hands, the other side can be red hot.

Personnel practice emergency water rescue operations using manikins to simulate an astronaut crew member. The maneuvers were first conducted on a wood and fiberglass mock-up of the Orbiter at a small pond south of the Shuttle Landing Facility in the summer of 1980.

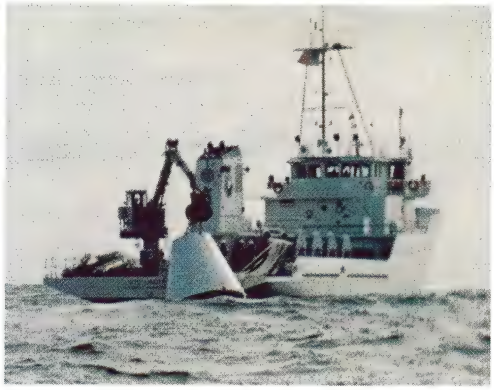
Frogmen practice emergency rescue procedures.

Space Shuttle Orbiter being prepared to be lifted up and mated to already prepared fuel tank and rocket boosters.

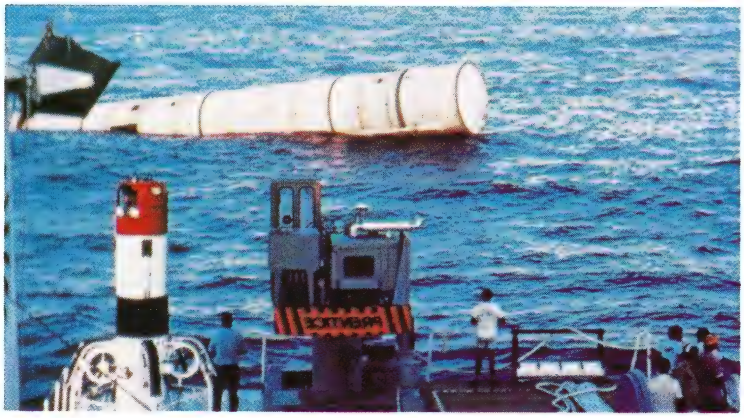
Following its move from the Orbiter Processing Facility to the cavernous Vehicle Assembly Building, the Space Shuttle Orbiter Columbia is prepared for hoisting and mating operations with the external tank, which will complete the assembly of the first Space Shuttle vehicle. Attached to its handling sling, the Orbiter will be rotated to a vertical position, lifted 59.5 meters (190 feet) above the VAB floor, then swung over a large structural beam and slowly lowered to the deck of a mobile launcher platform in the assembly bay for mating with its external tank. The twin solid rocket boosters were erected on the mobile launch platform first; then several months later the 15-story tall external tank was added to the stack.

# Behind the Scenes

One of two specially outfitted ships used to recover the boosters from the sea after each launch of the Space Shuttle.



During recovery operations, each ship will pick up one of the boosters, its three parachutes, and nose cone.



The highly trained recovery crew uses special equipment to handle the solid rocket boosters.

Aerial view of solid rocket booster disassembly and refurbishment facility.

Specially designed parachutes are used to slow the jettisoned rocket booster casings to a soft landing in the Atlantic Ocean. All parts recovered are returned to a special cleaning facility where salt water is washed away and boosters are disassembled and all reusable items are readied for another flight.

# Shuttle Era

The Space Shuttle is America's newest and most versatile manned spacecraft. Unlike its predecessors — Mercury, Gemini and Apollo — it is a reusable aircraft-like ship which is designed for years of service and makes space flight a relatively economical and routine event.

The Shuttle will provide a flexibility never before achieved in space operations, and will allow space to be treated as the resource it is rather than as a hostile environment to be tested, examined and explored. Shuttle will enable us to use hard vacuum and zero gravity for further development of material processing in space. Space flight has opened up this new environment which we have only begun to understand and take advantage of.

Experiments planned for Shuttle flights will help identify the problems and possibilities of long term research and habitation.

The Orbiter's large cargo capacity and relatively mild launch environment will enable it to carry into orbit a variety of satellites, including some which could not be launched before because of size, shape, weight or sensitivity to launch forces.

The potential of space is unlimited. The United States is ready now to economically utilize space for the benefit of mankind.

Columbia heads for the pad — first step into space.

# The Shuttle Era

The Space Shuttle was developed by the National Aeronautics and Space Administration. NASA manages and operates the space transportation system, including coordination of launch and space flight requirements for civil government, commercial, and military use.

The Space Shuttle system consists of four primary elements: an Orbiter spacecraft, two solid-rocket boosters and an external tank to hold fuel and oxidizer.

The Shuttle will transport into near earth orbit up to 29,484 kilograms (65,000 pounds) of cargo. This cargo is carried in a bay 5 meters (15 feet) in diameter and 18 meters (60 feet) long. It can bring back from space cargo weighing as much as 14,515 kilograms (32,000 pounds).

The Orbiter will normally carry a flight crew of three and up to four payload and mission specialists. Additional passengers, a total of ten persons, could be carried under emergency conditions.

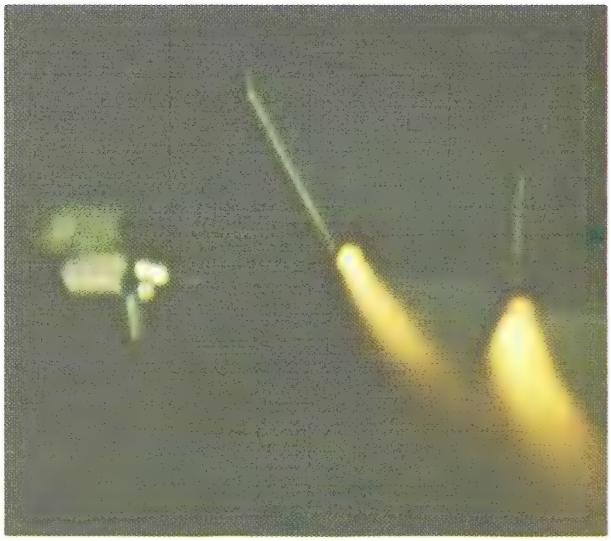
Basic mission time is seven days in space. With additional supplies, this can be extended to thirty days.

The Orbiter's crew compartment has a shirt-sleeve working environment, much like any earthly job. The acceleration load at launch or re-entry is never greater than three times normal gravity, and allows non-astronaut scientists and technicians to be members of the flight crew.

The Shuttle is launched in an upright position with thrust provided by the three main engines and the two solid rocket boosters. About two minutes after liftoff, the boosters are spent and separated from the Orbiter. They drift to the Earth by parachute and are recovered to be used again. The main engines continue burning for about eight minutes. Then the external tank is separated, falling back into a remote area of the Indian Ocean but not recovered.

The mission begins shortly after orbital entry as the crew and passengers get down to the business of living and working in the unique environment of space.

Shuttle Columbia on launch pad



Separation of the Space Shuttle's solid rocket boosters occurs at two minutes, 11 seconds after launch from Pad A, Launch Complex 39. This photo showing separation and falling away of the two booster casings still spewing sparks from their white-hot linings, was taken by a 35mm motion picture camera approximately 31 miles south of Launch Pad A.

The forward fuselage structure of the Orbiter is composed of aluminum alloy panels, frames and bulkheads. The crew section is supported within this fuselage by four attach points and is welded to create a pressure-tight vessel. The module for the crew has a side hatch for normal ingress and egress and a hatch from the airlock into the payload bay for access to the outside.

John Young and Robert Crippen were the astronauts selected to fly Columbia on its maiden flight. Young, the Mission Commander, was a veteran of four space flights and had logged 533 hours and 33 minutes in space flight on the Gemini 3 and 10 missions and the Apollo 10 and 16 flights to the Moon.

Thumbs up for a good trip — Astronauts Young and Crippen during training for first flight of Space Shuttle Columbia.

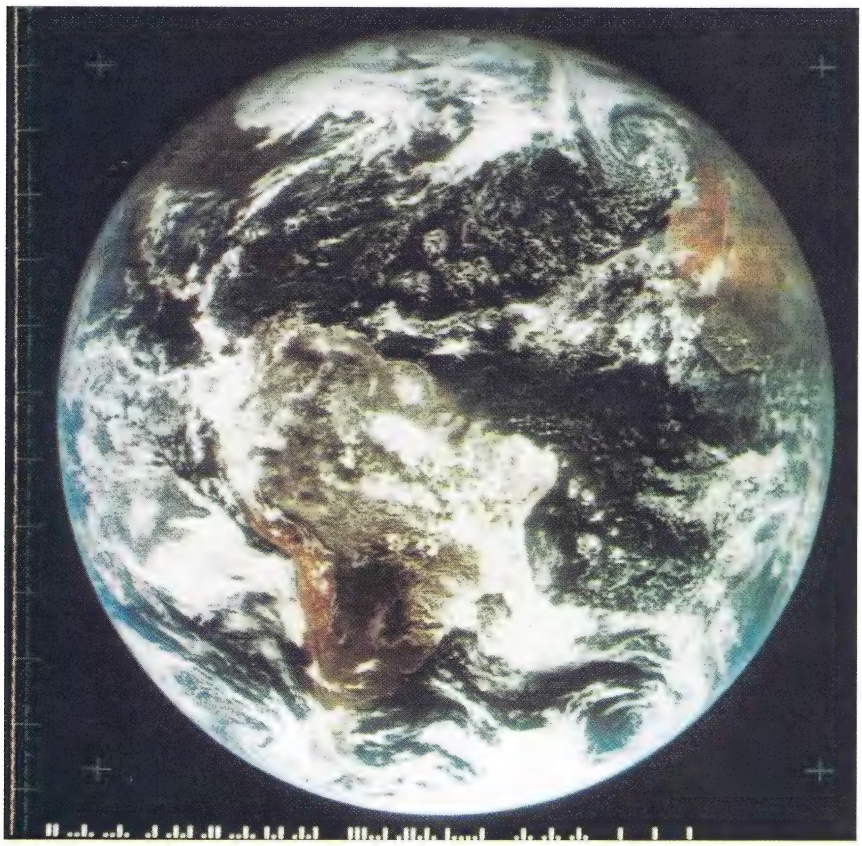
Crew members ready for re-entry (artist concept)

Shuttle crew enjoys balanced meals while in flight (artist concept)

Young entered U.S. Naval service after college and is a graduate of the U.S. Navy's Test Pilot School. In 1975 he was named Chief of the Astronauts Office. Born in San Francisco, California in 1930, Young is married and has two children.

Robert Crippen, the Mission Pilot, was one of the research pilots originally selected for the U.S. Air Force's Manned Orbiting Laboratory. Before making his first space flight in Columbia, he had logged more than 400 hours of flying time as a U.S. Navy pilot and astronaut. Crippen was born in Texas in 1937, is married and has three children.

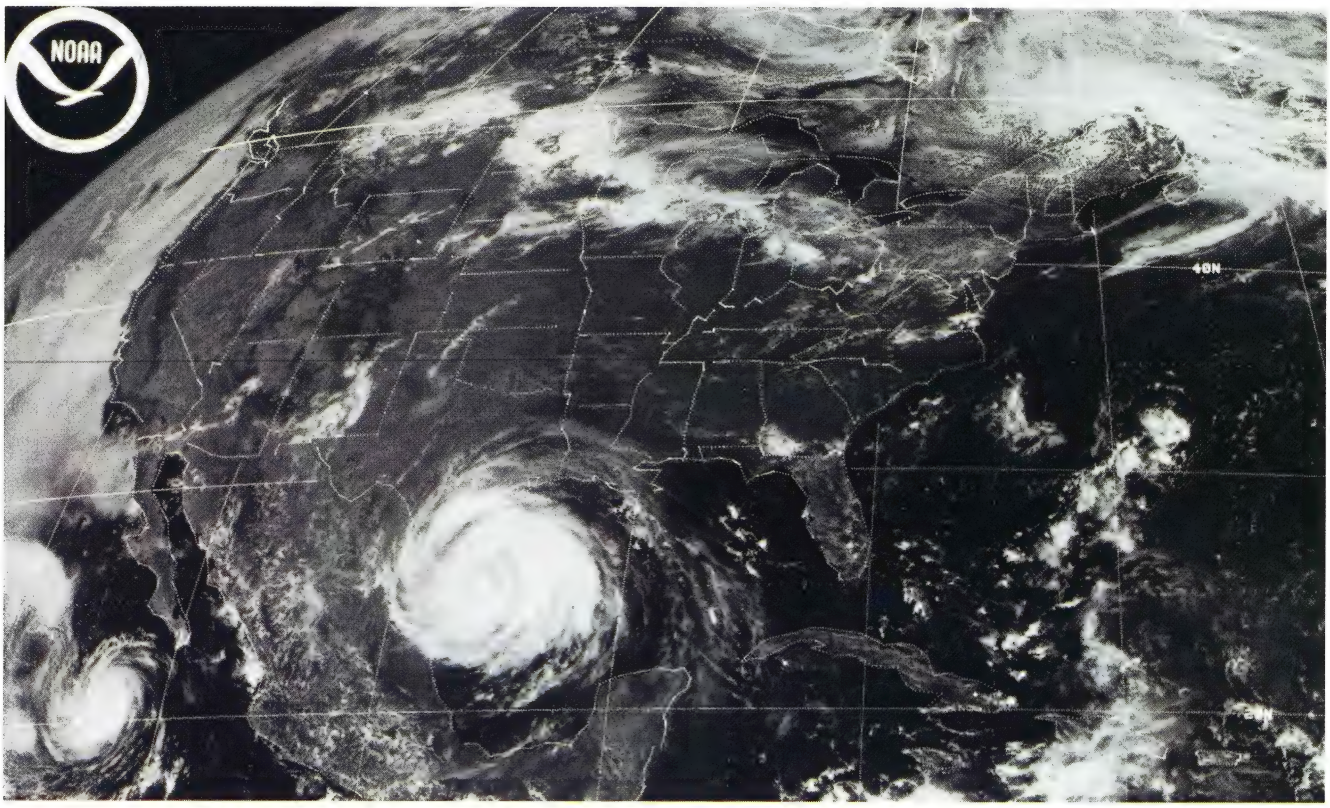
# Shuttle Era
## Benefits and Advantages



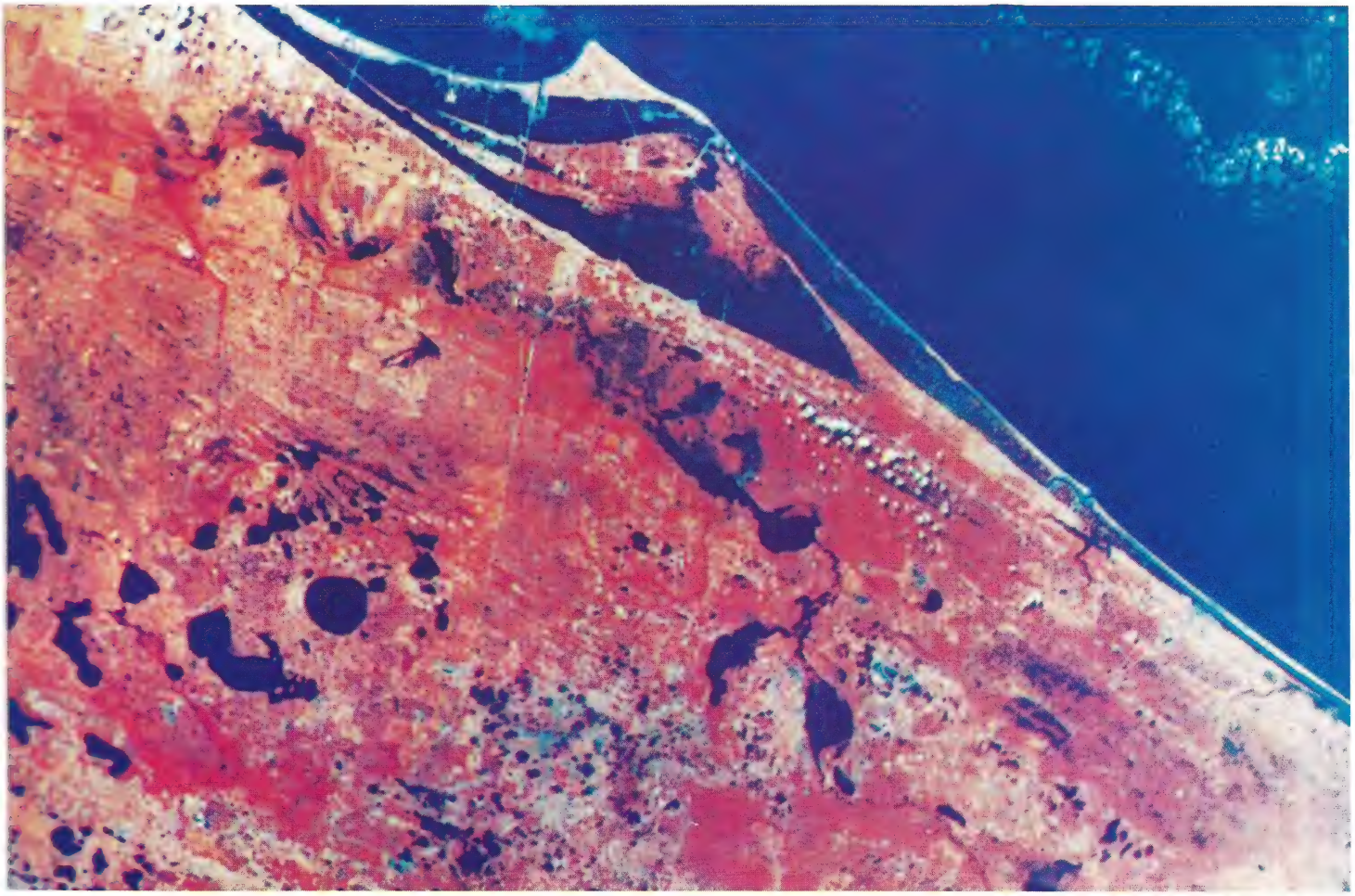
How we look from space — Satellites launched by Space Shuttle will cost less and provide better service.

In the mid 1970's, observations of large wheat-growing areas of the world from both weather and natural resources survey satellites were combined with surface information to measure acreage and estimate yields in a successful demonstration that crop forecasts could be improved with data from space. Information was gathered not only over the United States, but also over Canada, Russia, China, India, Australia, Brazil and Argentina. Obviously, early production estimates made regularly in this way could be of significant help in planning food distribution and avoiding the market shocks of unforeseen shortages and bumper harvests.

Pictures and computer data from a series of Earth resources survey satellites and also from the manned Skylab space station were used in dozens of ways in the 1970's to help federal agencies, state and local governments, regional planning authorities, private industry, and foreign countries manage limited natural resources and monitor the threatened environment.




Weather satellites launched by Space Shuttle will continue to provide the watchful eyes needed to track hurricanes and other powerful weather systems.



Infrared photo of Cape Canaveral Air Force Station and surrounding area.

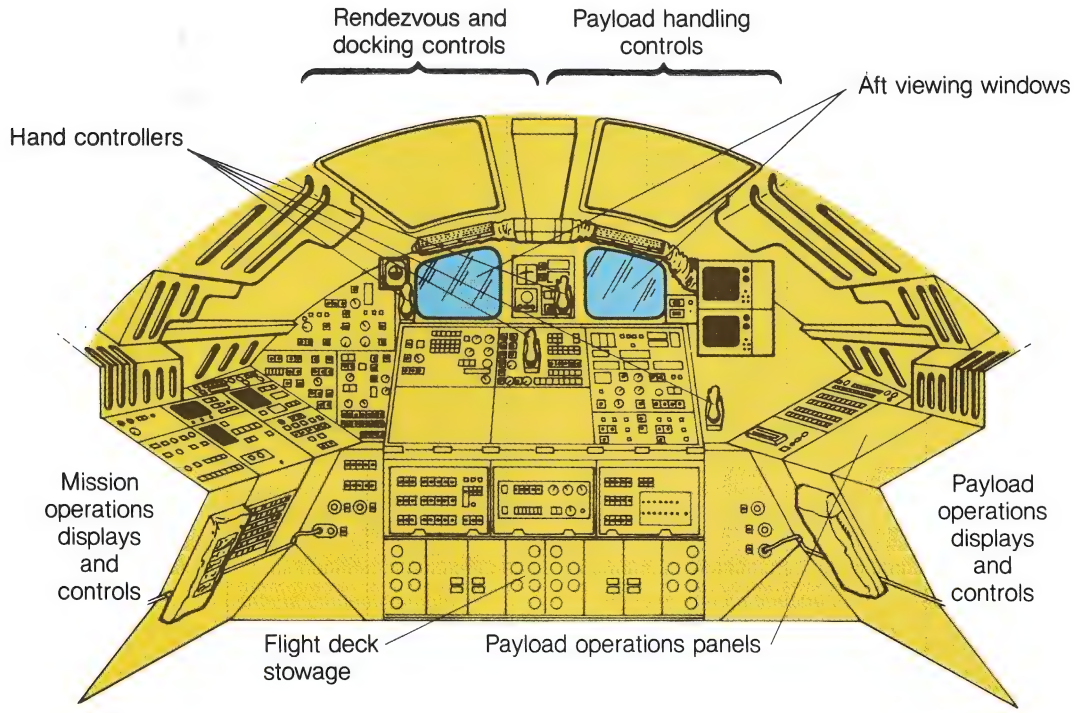
The use of infrared photography from space allows large amounts of specific useful information to be gathered quickly and efficiently. In a photo of the Earth, for example, the general health and vigor of green plants can be determined and used as an indicator of potential disease or insect problems. Water quantity and quality can be easily measured and the data used to aid agriculture and forestry planning and production. In general, the red color in an infrared photo shows where green plants are, while the dark blue or black shows water locations. White areas usually indicate bare ground or pavement.

Space Shuttle flights will allow more frequent Earth observations with larger camera and sensor systems than previously available. Earth resource studies are expected to be an important part of Space Shuttle usage.

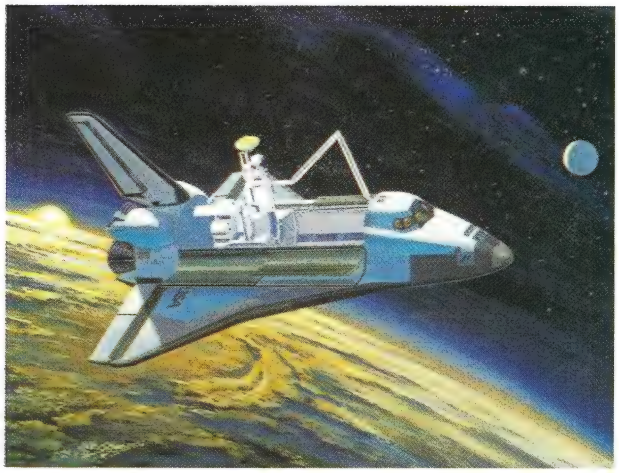
This photo of the State of Florida taken by Astronauts on the Apollo 9 mission shows features and details not readily obtainable by any other means. Cape Canaveral, Tampa Bay and Lake Okeechobee are all readily visible.

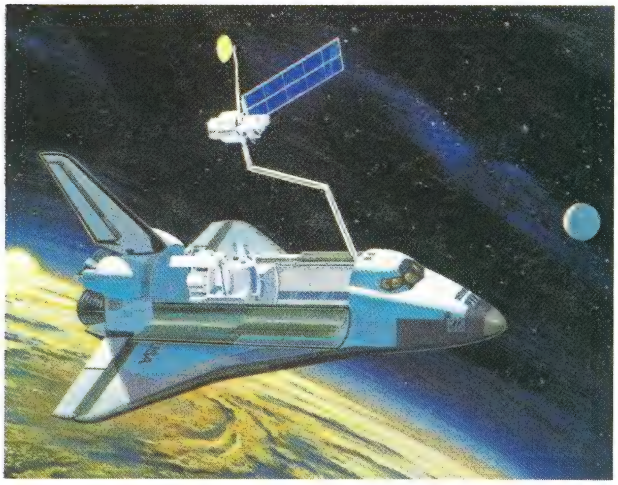
# Shuttle Era
## Benefits and Advantages

Aft deck of Space Shuttle Orbiter




The aft flight deck is where a great deal of work will be accomplished. Instruments and controls on the left of center are for the operation of the Orbiter, while those on the other side are for operating and handling the payloads. This area contains displays and controls for manipulating, deploying, releasing and capturing satellites. Also included are controls for opening and closing the payload bay doors and operating the large manipulator arm used for cargo handling. Two closed circuit television monitors display video pictures for overseeing cargo bay operations. Thus the crew stations are designed to permit a maximum of activities to be remote controlled from inside the crew cabin. This minimizes the number of outside activities for any given mission, and so there should be only a limited number of flights in which the crew has to venture outside the safety of their pressurized cabin.





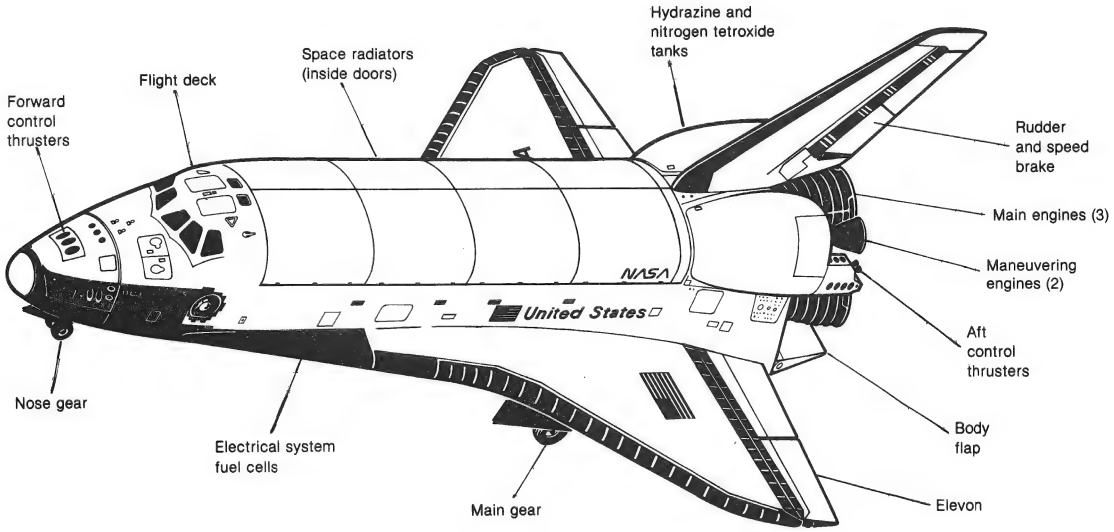
A special mechanical arm is mounted in the Orbiter's cargo bay to lift out and deliver the payload. This same arm can be used to pick up or retrieve objects and place them into the cargo bay for return to Earth. The arm is remotely operated by a crew member from inside the crew compartment.

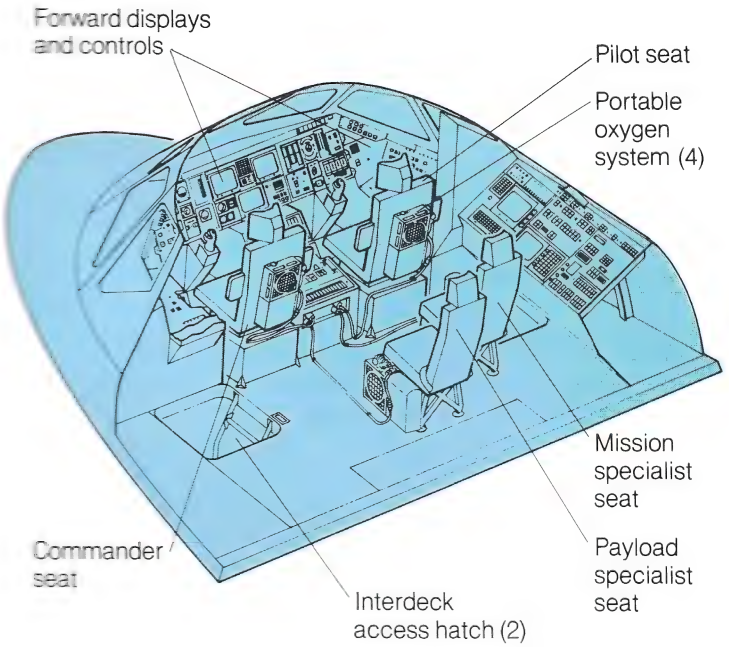
# Shuttle Era

## A Space Truck — The Orbiter

Four Shuttle Orbiters, each with accommodations for up to seven persons, are scheduled to make many round trips a year to low Earth orbit and back. Shaped like an airplane, the 37.2 meter (122 foot) long Shuttle Orbiter will lift off like a rocket, orbit like a spacecraft on seven to thirty-day missions and return to Earth on a landing strip like a glider or airplane.

The Shuttle will function as a "freight" carrier, delivering and launching satellites in space and bringing some back to Earth within its payload bay. It will also serve as a traveling repair shop for orbiting satellites that are ailing, a science lab for space experiments and observations and as a factory for manufacturing products in zero gravity, such as perfect crystals. In addition, the Shuttle could deliver supplies to Earth orbit to construct future space stations.




Flight deck of Space Shuttle Orbiter looking forward.

The commander and pilot are seated here during launch, flight and reentry.

The compartment is configured to accommodate a crew of three on the flight deck with an additional seat for one more on flight deck and three in the mid deck.

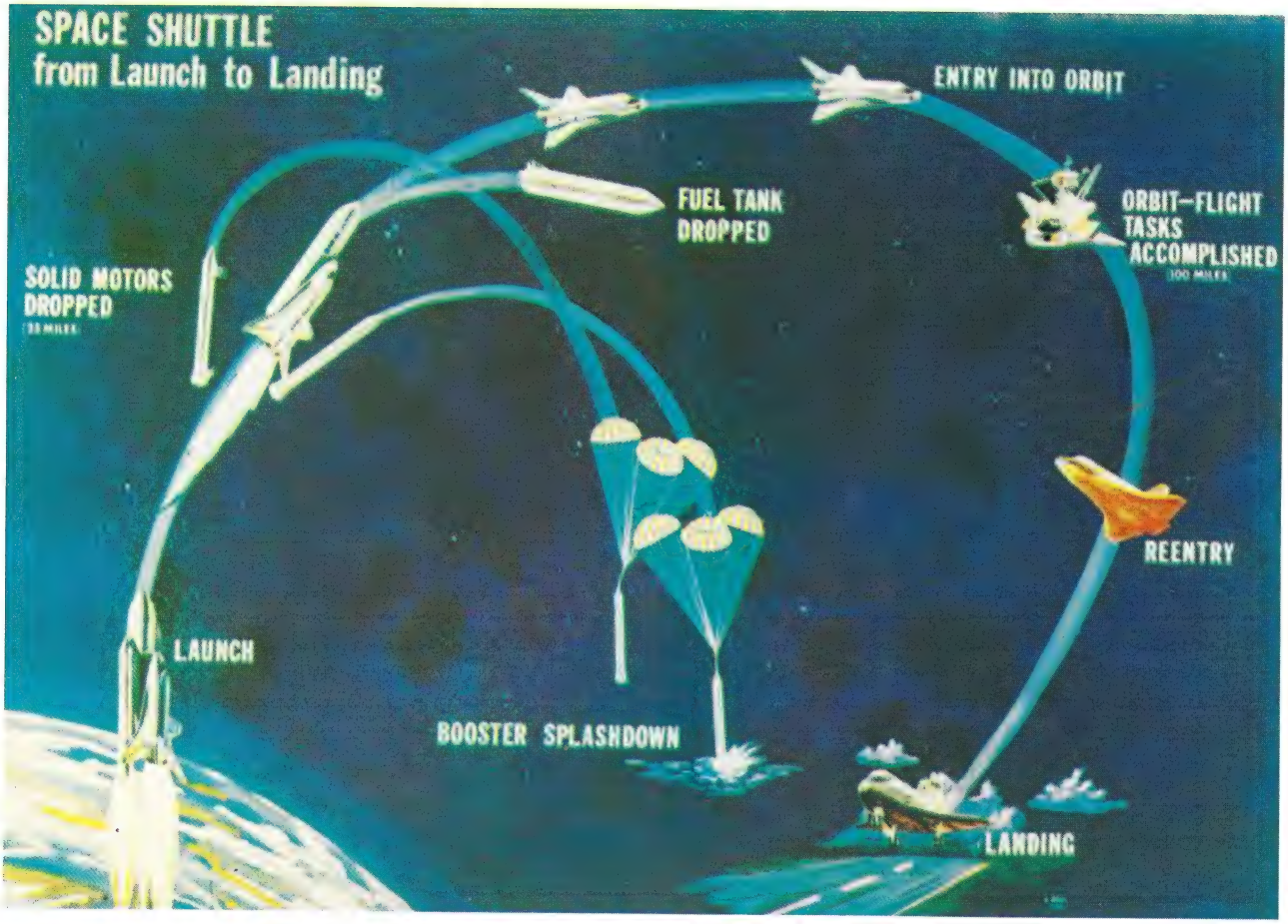
In the operational flights, directly behind and to the sides of the commander and pilot are the mission and payload specialist seats.

The mission specialist is located on the right side of the Orbiter and has controls and displays for monitoring systems and displays.

Sleep stations and a galley are installed in the mid deck; in addition, three passenger seats can be installed and three more can be placed there for rescue missions if the sleep stations are removed.

The cabin module is designed to be a combination working, living and storage area. The lower section is the equipment bay containing environmental controls for life support and more storage. The area is accessible through hinged floor panels.

# Shuttle Era




In a typical Shuttle mission, which could last from seven to thirty days, the Orbiter's main engines and the boosters ignite simultaneously to rocket the Shuttle from the launch pad.

At a predetermined point, the two solid rocket boosters separate from the Orbiter and parachute to the sea where they are recovered for reuse. The Orbiter continues into space and jettisons the external propellant tank just before entering orbit. The external tank enters the atmosphere and breaks up over a remote area of the Indian Ocean.

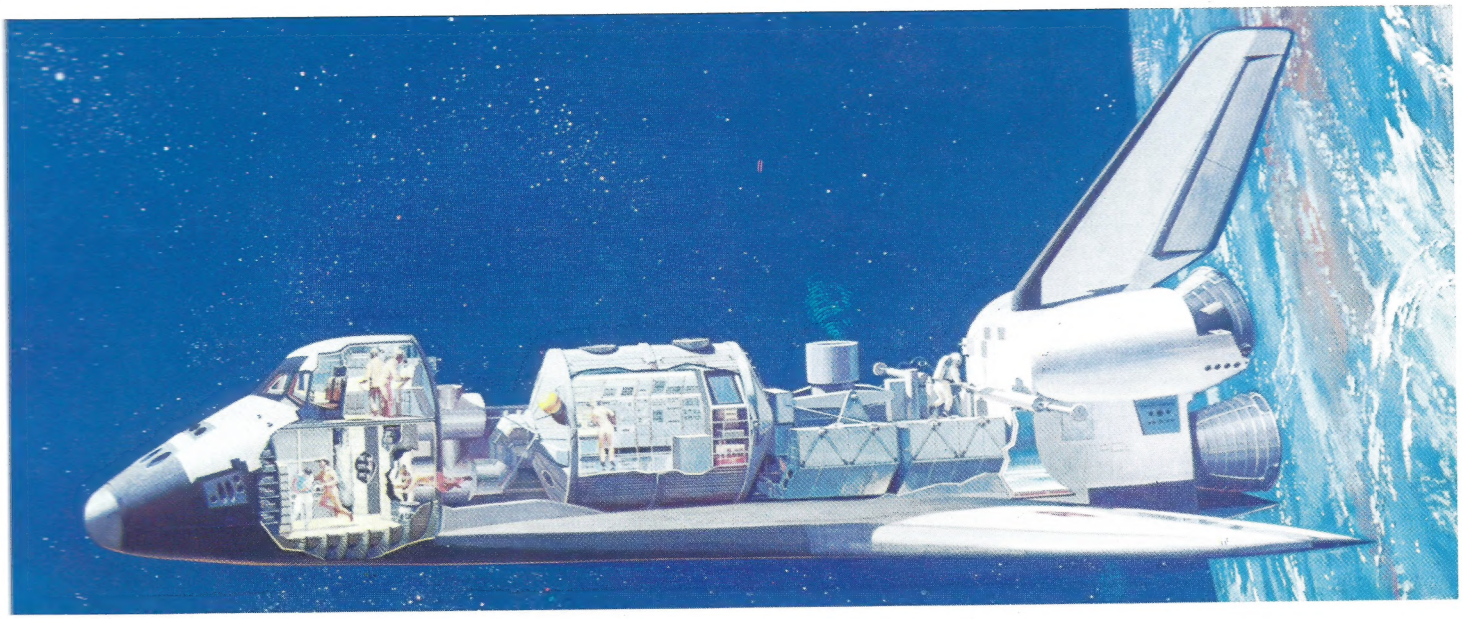
In orbit, the Orbiter uses its orbital maneuvering system to adjust its path, to conduct rendezvous operations and, at the end of the mission, to slow down for return to Earth. The orbital maneuvering system propellants, which ignite on contact, are monomethyl hydrazine as the fuel and nitrogen tetroxide as the oxidizer.

The Orbiter does not follow a ballistic path to the ground as did earlier manned spacecraft. It can maneuver to the right or left of the entry path as may be required to permit a safe landing.

A special insulation that sheds heat so readily that one side is cool enough to hold in bare hands while the other side is red hot serves as the Orbiter heat shield. The insulation will withstand temperatures up to 1650°C (3000°F) for as many as 100 flights with little or no refurbishment. Previous manned spacecraft used heat shields that charred to carry heat away during the fiery entry into the Earth's atmosphere.

The Orbiter touches down like a glider on a runway at the Kennedy Space Center or Vandenberg Air Force Base. The landing speed is approximately 335 km (215 miles) per hour.

# Shuttle Era
## Spacelab



Artist concept of Spacelab in the payload bay of the Orbiter

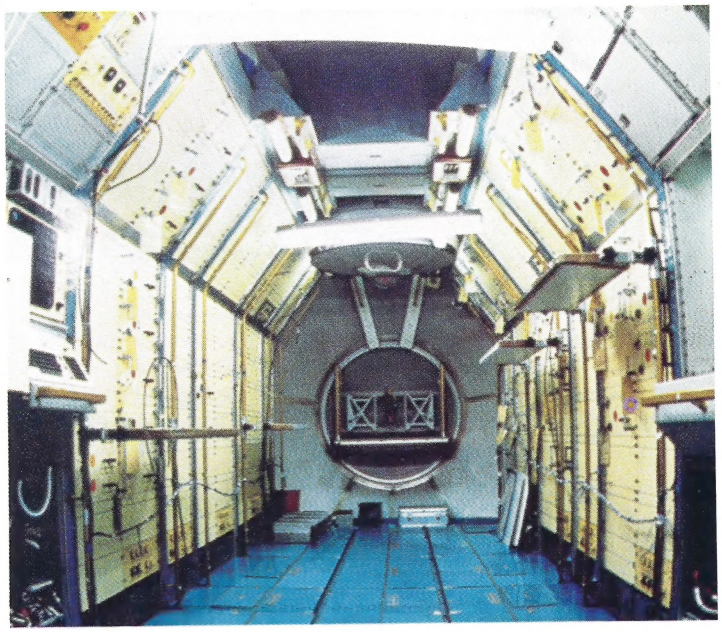
The Space Shuttle Orbiter is designed to accommodate a wide range of payload missions. One of the most interesting planned is "Spacelab," the European Space Agency's contribution to the Space Shuttle program. Spacelab is a multi-purpose scientific laboratory designed for manned space experimentation and operation. The future non-astronaut scientists, engineers and technicians will be able to conduct in-orbit experiments that require close human supervision. Thus a scientist can go into space with his own experiment, keep close watch and make evaluations and observations "on the spot." This capability will be offered by the reusable Spacelab that will carry experiments into Earth orbit where the originators or/and technicians can carry out their work in "real time," working in a shirt-sleeve atmosphere.

The Space Shuttle system was developed to provide routine and economical access to space. Improving on the technology and operational experience of the Apollo and Skylab programs, the Shuttle substantially reduces costs of orbital operations by re-flying most major components. Each Spacelab, for example, is designed to be flown fifty flights over a ten year period.

Spacelab will be carried into space in the large cargo bay of the Orbiter. Work will be completed and Spacelab will return to Earth and removed from the Orbiter intact, re-outfitted and readied for another trip. Spacelab can also be outfitted with an external instrument platform or "pallet" for telescopes, antennas and other large remotely controlled instruments requiring direct exposure to space or a broad field of view. Experiments mounted on the pallet can be controlled from the ground via the control center in Houston, Texas.

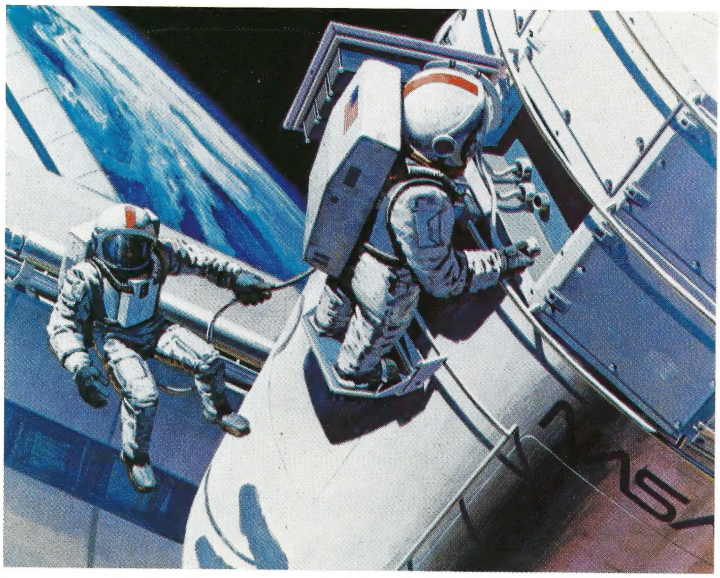
Among the many uses for Spacelab are zero gravity studies in materials science and technology, Earth surveys, astronomical observations and biomedical applications.

With Spacelab launched and recovered routinely as part of the Space Shuttle system, researchers from a wide variety of fields will be able to apply their own creative talents in orbit for the first time.



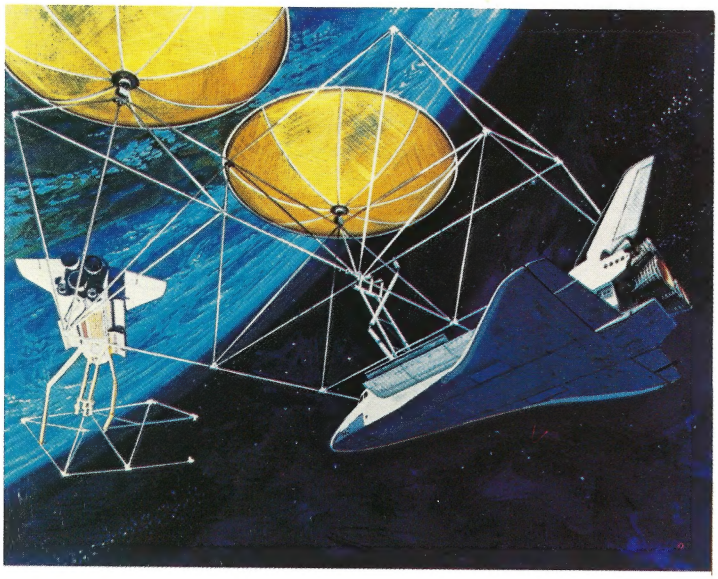
Laboratory and control room of Spacelab.

# Shuttle Era
## The Future

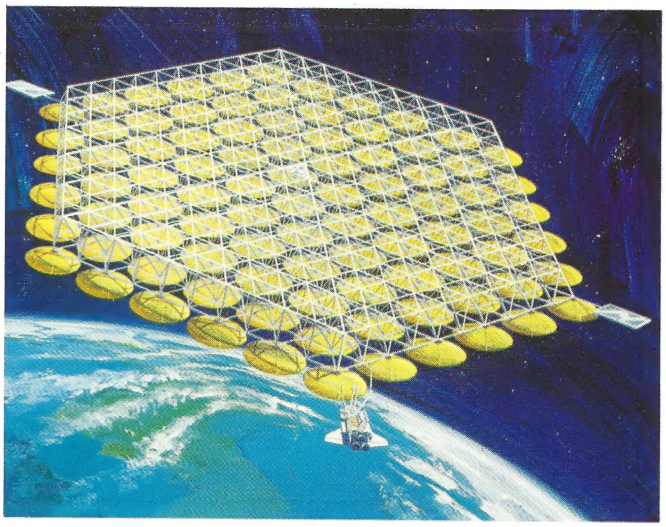


Two members of a Space Shuttle crew make ready to use the new giant telescope being planned for space use within a few years. Placed above the Earth's atmosphere, this giant seeing eye will be able to focus into space seven times farther than similar instruments on Earth. The information obtained by scientists in this manner will greatly enhance our knowledge of the deep space void. (artist concept)

An orbiting solar power station can supply the large amounts of electrical power that would be needed for extended missions, and for many experiment packages which use large amounts of electricity.



The Space Transportation System's capability for erecting large structures in space offers vast potential. Being considered is an unmanned platform for scientific data collection and direct benefit applications which would house, in a single orbiting package, the equipment and functions that now require a number of different satellites.



We have the capability of building extremely large multi-beam antennas in space which can broadcast information directly to the individual user. With this technology, pocket telephones, direct broadcast TV, electronic teleconferencing, and dozens of other uses can become cost-effective and practical.

The crew members of the first Space Shuttle flight, Astronauts John Young (right) and Robert Crippen (left) pose with the Visitors Center Spaceman. The two Astronauts came to the Visitors Center to take part in the First Day of Issue Ceremony, held by the U.S. Postal Service, for the set of "Space Achievement" stamps (left).

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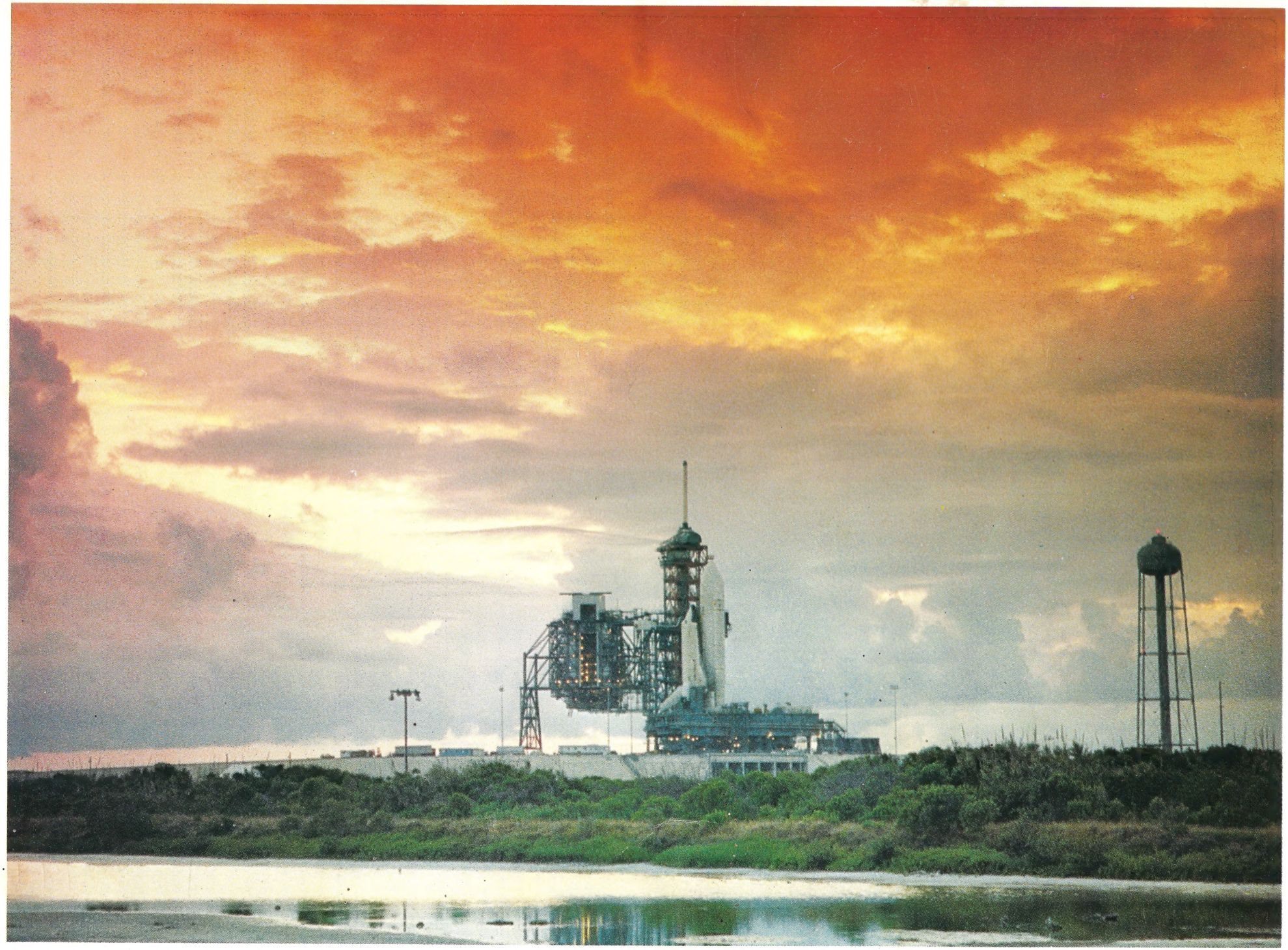

Space Shuttle "Enterprise" stands on KSC Pad 39 A outlined against the Florida sunset